AUG 1 1 1927

With METALLURGICAL SUPPLEMENT.

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLIV.—No. 3733] LONDON: FRIDAY EVENING, JULY 29, 1927 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 2d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for—

1. About 35,000 STEEL BOILER TUBES.
2. TUNNEL CENTRING EQUIPMENT.
3. 119 LOCOMOTIVE AXLES and 100 CARRIAGE and WAGON AXLES.
4. 8049 HELICAL and VOLUTE SPRINGS.
5. 500 M.S. WELDLESS BUFFER SOCKETS and 3000 PRESSED STEEL DRAWBAR CRADLES.

Tenders due on the 12th August, 1927, for No. 1, and on the 16th August, 1927, for Nos. 2 to 5.

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 6119

Assistant Engineers (2) REQUIRED for the KENYA and UGANDA RAILWAY for a tour of 20 to 30 months' service, with possible extension. Salary £480, rising to £720 a year. Free quarters and passages and liberal leave on full salary. Outfit allowance of £30 on first appointment. Candidates, unmarried, 22-28 years of age, must have passed examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications, and have had some experience on Railway Civil Engineering Work.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting at head of application M/15466. 6084

Assistant Engineers (2) REQUIRED for the RAILWAY DEPARTMENT of NIGERIA for a tour of 12 to 18 months' service, with possible extension. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25 to 35, must have passed examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications, and have had experience in maintenance and construction on a recognised railway in the United Kingdom or a British Colony. A good knowledge of surveying is essential.—Apply at once by letter, stating age and particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15394. 6085

Assistant Engineers (20) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other diploma or distinction in engineering as the Secretary of State may decide in any particular case or have completed articles with a civil engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15224. 6105

Wanted at Once, Temporary ENGINEERING ASSISTANT for London office, with sound knowledge and recent practice of Structural Steel Work Design. Preference given to ex-Service men. Apply, giving full particulars of experience, age, salary required, when disengaged, and enclosing copies of recent testimonials, to CIVIL ENGINEER-IN-CHIEF, Admiralty, S.W. 1. 6082

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that WALTER JOHN UNDERWOOD, Captain, late of the Royal Artillery, of 1, Fernshaw Mansions, Fernshaw-road, Chelsea, London, S.W. 10, SEEKS LEAVE to AMEND the SPECIFICATION of the APPLICATION for LETTERS PATENT No. 269,452, for an invention entitled "Improvements in or relating to Mechanism for Operating Three-position Railway Signals."

Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 20th July, 1927.

Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

(Sgd.) W. S. JARRATT,
Comptroller-General.
3466

University of Birmingham.

DEPARTMENT OF METALLURGY.

"FEENEY" PROFESSOR: D. HANSON, D.Sc.

THE SESSION 1927-28 COMMENCES ON OCTOBER 3rd, 1927.

The Course of Study covers three years and leads to the Degree of B.Sc. in Metallurgy. There is also an Honours School. Special attention is devoted to Iron and Steel, Copper, Brass, Metallography, the needs of local industries and to preparation for Colonial and Foreign Posts.

Research and other Scholarships.

For particulars apply to the REGISTRAR. 6076

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Metallurgist.
THE ENGINEER, 29 - 7 - 27.

An American Diary—No. I.
THE ENGINEER, 29 - 7 - 27.

Main Line Electrification—No. XIX (Italy).
(SIR PHILIP DAWSON & S. PARKER SMITH.) THE ENGINEER, 29 - 7 - 27.

The Tâf Fechan Reservoir.
THE ENGINEER, 29 - 7 - 27.

The Geneva Naval Discussions.
THE ENGINEER, 29 - 7 - 27.

A Welsh Power Transmission Scheme.
THE ENGINEER, 29 - 7 - 27.

The Design of Boiler Furnaces.
(WOHLENBERG & BROOKS.) THE ENGINEER, 29 - 7 - 27.

Institution of Naval Architects: Cambridge Meeting, Visits.
THE ENGINEER, 29 - 7 - 27.

New All-metal Flying Boat.
THE ENGINEER, 29 - 7 - 27.

INDEX TO ADVERTISEMENTS, PAGE 79.

PUBLIC NOTICES

Armstrong College,

NEWCASTLE-UPON-TYNE.

(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
Newcastle-upon-Tyne.
5805

Crystal Palace School of Practical ENGINEERING,
Founded 1873.

MECHANICAL AND CIVIL ENGINEERING DIVISIONS.

PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.

Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 5881

PUBLIC NOTICES

BRADFORD EDUCATION COMMITTEE

TECHNICAL COLLEGE.

Full-time Day Courses are arranged to meet the needs of students wishing to present themselves for the Degree Examinations of the London University in

MECHANICAL ENGINEERING,
CIVIL ENGINEERING,
ELECTRICAL ENGINEERING.

Further Particulars and Prospectuses may be obtained on application to

The PRINICIPAL, TECHNICAL COLLEGE,
BRADFORD. 6086

The Yarrow and William LINDLEY SCHOLARSHIPS.

The Council of the Institution of Civil Engineers are prepared to consider APPLICATIONS for APPOINTMENT to the above SCHOLARSHIPS. These should be submitted before the 17th September, 1927, to the SECRETARY of the Institution at Great George-street, Westminster, S.W. 1, from whom the detailed regulations may be had on application.

Applicants for the Yarrow Scholarships must be British subjects who are not more than 23 years of age and who, desiring to become engineers, lack sufficient means to enable them to pursue their practical training or their scientific education. The Scholarships are ordinarily of values from £50-£100 per annum for one, two, or three years.

Applicants for the William Lindley Scholarships must not be more than 23 years of age and must be children of Corporate Members of the Institution whose means are inadequate to defray all the expenses incidental to an engineering training. The fund provides for (a) a major scholarship of £80 per annum for engineering study at Cambridge University, tenable for three years; and (b) a scholarship of £40 per annum for scientific education or practical training in engineering. 6077

PUBLIC NOTICES

UNIVERSITY OF LONDON.

King's College.

FACULTY OF ENGINEERING.

COMPLETE COURSES of STUDY are provided in CIVIL, MECHANICAL and ELECTRICAL ENGINEERING for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.

HEADS OF DEPARTMENTS:

Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering (Dean).

S. J. DAVIES, M.Sc., M.I. Mech. E., Reader in Mechanical Engineering.

Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.

C. H. LOBBAN, D.Sc., A.M. Inst. C.E., Reader in Civil Engineering.

Professor E. WILSON, M. Inst. C.E., M.I.E.E., Electrical Engineering.

F. S. ROBERTSON, M.I.E.E., Senior Lecturer.

Professor S. A. F. WHITE, M.A.
Professor A. E. JOLLIFFE, M.A. } Mathematics.

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 6073

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for:—

STEEL AXLES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 25th July, 1927.

A fee of 10s. will be charged for the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Thursday, 4th August, 1927.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
Secretary.
25th July, 1927. 6080

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for:—

26 BOILERS for "H" CLASS ENGINES, 5ft. 6in. gauge.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 22nd July, 1927.

A fee of 20s. will be charged for the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Friday, 5th August, 1927.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
Secretary.
22nd July, 1927. 6081

The Madras and Southern MAHRATTA RAILWAY COMPANY, Ltd., 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for:—

GIRDER BRIDGE SPANS of 10, 20, 24, 40 and 60ft., approximate total tonnage of 485 tons.

Tenders are due in on Friday, 19th August, 1927, by 10.30 a.m. Tender form obtainable at above address; fee One Guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 6103

PUBLIC NOTICES (continued) Page 2.
SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PARTNERSHIPS, Page 2.
AUCTIONS, Page 80.
EDUCATIONAL, Page 2.
MACHINERY, &c., WANTED, Page 3.
AGENCIES, Page 2.
FOR HIRE, Page 2.
FOR SALE, Pages 3, 4 and 80.
PATENTS, Page 3.
MISCELLANEOUS, Page 2.
BUSINESSES and PREMISES (For Sale, etc.), Page 80.
WORK WANTED, Page 3.

For Advertisement Rates see Leader Page.

PUBLIC NOTICES

Belfast Harbour.

The Belfast Harbour Commissioners Invite TENDERS for the CONSTRUCTION, ERECTION and SETTING to WORK on the Quays at Belfast, where pointed out, of FOUR ELECTRICALLY DRIVEN GANTRY CRANES (3-phase, A.C., 380 volts, 50 cycles).

Outline specification, form of Tender, and any further information required may be obtained from the Harbour Engineer, Mr. T. S. Gilbert, M. Inst. C.E.

Tenders must be made out on the special form provided for the purpose and enclosed in a sealed envelope, addressed to the undersigned and endorsed "Tender for Electric Cranes," and delivered on or before Wednesday, the 10th August, 1927.

The Commissioners do not bind themselves to accept the lowest or any Tender.

M. J. WATKINS,
General Manager and Secretary.

Harbour Office, Belfast,
20th July, 1927. 6078

City of Nottingham.

WOLLATON-ROAD WIDENING.
BRIDGE OVER NOTTINGHAM CANAL.
CONTRACT NO. 1.
TO CONTRACTORS.

The Works and Ways Committee is prepared to receive TENDERS in connection with the CONSTRUCTION of the above BRIDGE, consisting of Concrete and Brick Abutments, also of Brick and Concrete Retaining Walls and Embankments to Bridge Approaches.

The steel work is to be carried out under a separate contract. Drawings may be seen, and copies of the general conditions of contract, specification, bill of quantities, and form of Tender, &c., may be obtained on and after Wednesday, 3rd August, 1927, on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of Two Pounds, which will be returned on receipt of a bona fide Tender.

Sealed Tenders are to be delivered in the official envelope provided to the undersigned not later than 6 p.m. on Thursday, 18th August, 1927.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from firms who conform to the conditions of the contract as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham district.

By Order,
W. J. BOARD,
Town Clerk.

Guildhall, Nottingham,
26th July, 1927. 6093

City of Nottingham.

WOLLATON-ROAD WIDENING.
BRIDGE OVER NOTTINGHAM CANAL.
CONTRACT NO. 2.
TO STRUCTURAL ENGINEERS.

The Works and Ways Committee is prepared to receive TENDERS for about

103 TONS of STEEL WORK in PLATE GIRDERS, TROUGH FLOORING, &c.,

required in connection with the construction of the above bridge.

Drawings may be seen and copies of the general conditions of contract, specification, bill of quantities, and form of Tender, &c., may be obtained on and after Wednesday, 3rd August, 1927, on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of Two Pounds, which will be returned on receipt of a bona fide Tender.

Sealed Tenders are to be delivered to the undersigned in the official envelope provided not later than 6 p.m. on Thursday, 18th August, 1927.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from firms who conform to the conditions of the contract as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham district.

By Order,
W. J. BOARD,
Town Clerk.

Guildhall, Nottingham,
26th July, 1927. 6094

Government of Egypt—Ministry of Public Works.

TENDERS will be received at the office of the DIRECTOR-GENERAL, Mechanical Department, Public Works Ministry, Cairo, until noon, 12th October, 1927, for the SUPPLY and ERECTION at site of Atf Power Station of FOUR INTERNAL COMBUSTION DIESEL ALTERNATOR GROUPS and ACCESSORIES.

Conditions of Tender, specifications and drawings may be obtained from the office of the Chief Inspecting Engineer, Egyptian Government, 41, Totbill-street, London, S.W. 1, against payment of Twenty-one Shillings per set (which payment is not returnable). 6109

Macfarlane and Robinson, LIMITED,

BUSHBURY WORKS,
WOLVERHAMPTON,

INVITE TENDERS for the WHOLE of their PLANT and MACHINERY, TOOLS and other Effects, comprising Deep Stamping and Drawing Presses, Spinning Lathes, Circling and Cutting Machines, Travelling Conveyors, Grinding Mills, Spot Welders, &c.

Inspection at the works invited by arrangement.

Apply, SECRETARY. 6098

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. BRASS and STEEL SCREWS.
2. GRINDING MACHINES.
3. SCREWING MACHINES.
4. BOLT and NUT SHOP MACHINERY.
5. PIPE WORK (lt.).
6. STEEL BEARING PLATES (approx. 1360 Tons).
7. PAINTS and DRYSALTERIES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Brass and Steel Screws," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 12th August, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 2s. 6d. for each copy of Specification No. 1, of 5s. for each copy of Specifications Nos. 2, 3, 4 and 5, and of £1 for each copy of Specifications Nos. 6 and 7.

Copies of the drawings may be obtained from the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
29th July, 1927. 6108

CONTRACTORS.

Tenders are Invited for the

CLEANING OUT of 4½ MILES of WATERWAYS, SUPPLY and ERECTION of EJECTOR PLANTS, ELECTRIC LIGHTING INSTALLATION, PUMPING PLANT, and FIRE HYDRANT SYSTEM at Amberley Castle, Sussex.

(Works can be tendered for by sections.)

Specifications, plans and forms of Tender on payment of One Guinea (which will not be returned) on application to

R. M. STEELE,
Consulting Engineer.

235, Icknield Way,
Letchworth, Herts. P3443

PUBLIC NOTICES

Reigate Board of Guardians.

INSTALLATION OF STEAM DISINFECTOR.

TENDERS are INVITED for Prices, Specifications and Drawings for the SUPPLY and INSTALLATION of a 6ft. by 3ft. STEAM DISINFECTOR APPARATUS, delivered free at the Guardians' Institution, Redhill. Further particulars on application to the Master, Guardians' Institution, St. John's, Redhill, Surrey.

FRANK C. MORRISON,
Clerk to the Guardians.

27th July, 1927. 6121

State Electricity Commission OF VICTORIA, AUSTRALIA,

22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Scheme, Victoria, Australia, of ONE 40-TON ELECTRICALLY OPERATED TRAVELLING CRANE, in accordance with Specification No. 27/58.

Copies of Tender form, specification, &c., will be available upon application to :—

The Agent-General for Victoria,
Victoria House, The Strand,
London, England.

Charge £5 5s. for four copies of Tender form, conditions of contract, specification, and drawings complete. This charge will be returned in the event of a bona fide Tender being received. Extra copies £1 11s. 6d. each, not returnable.

A preliminary deposit of £100 is to be lodged with Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered as directed in Clause 3 of General Conditions of Tendering, not later than 14th November, 1927.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE,
Acting Secretary.

5976

State Electricity Commission OF VICTORIA,

22-32, WILLIAM STREET, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Works, Victoria, Australia, of EIGHT TUBULAR STEAM COAL DRIERS, SEVEN ELECTRICALLY OPERATED BRIQUETTE PRESSES, and a CENTRAL WASTE COAL DUST COLLECTING SYSTEM, in accordance with Specification No. 27/42.

Copies of Tender forms, specification, &c., will be available upon application to :—

The Agent-General for Victoria,
Victoria House, The Strand,
London, England.

CHARGE.—£3 3s. for three copies of Tender form, conditions of contract, specification and drawings complete. This charge will be returned in the event of a bona fide Tender being received. Extra copies £1 1s. each, not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged at the office of the Agent-General for Victoria.

Tenders, on prescribed forms, properly endorsed and addressed, must be delivered at the office of the Commission, Melbourne, not later than 28th November, 1927.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE,
Acting Secretary.

6058

Surrey County Council.

The County Council offer FOR SALE a No. 6 Model CRANE TYPE RUSTON NAVVY EXCAVATOR, having a bucket capacity of ¾ to 7-8 cube yard, length of jib 20ft., caterpillar travelling gear, full housing accommodation, with all the incidental and necessary gear and appliances for the machine.

The machine was purchased in July, 1925, and is in excellent working condition, and may be seen on application at the County Council Depot, 38, Castlegardens, Deepdene, Dorking.

Offers to be addressed to the undersigned and delivered on or before the 13th August.

W. P. ROBINSON, A.M. Inst. C.E.,
County Surveyor.

Milner-road Annexe,
Kingston-on-Thames,
22nd July, 1927. 6083

The Assam-Bengal Railway

COMPANY, Limited, is prepared to receive TENDERS for :—

BODY IRONWORK and FITTINGS for CARRIAGES.
41½ Lb. RAILS and FISH-PLATES.
FISH BOLTS for 41½ Lb. F.F. RAILS.
DOG SPIKES for 41½ Lb. F.F. RAILS.

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2.

A fee of £1 1s. is charged for each specification, which cannot under any circumstances be returned.

Drawings may be had, at the cost of the tenderer, by application to Messrs. Hodges Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Wednesday, 17th August, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
THOS. C. BRETT,
Secretary.

27th July, 1927. 6110

Port of Sunderland.

APPOINTMENT OF ENGINEER.

The River Wear Commissioners are prepared to receive APPLICATIONS for the POSITION of ENGINEER for their Harbour and Dock Works.

Applicants must be duly qualified civil engineers and must have had experience of River, Harbour, Dock and Sea Works.

The gentleman appointed will be required to devote the whole of his time to the duties of his office and to reside within the borough.

Applications, stating age, qualifications, experience, and salary required, and accompanied by copies of not less than three recent testimonials, endorsed "Engineer," must be delivered to the undersigned not later than 6th August, 1927.

F. HUMBLE,
Clerk to the Commissioners.

Harbour and Dock Offices,
St. Thomas-street, Sunderland,
15th July, 1927. 6022

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ASSISTANT SUPERINTENDENT for large Works engaged on light mass production. Successful executive experience as well as a good practical knowledge of Tools and Methods necessary.—Address reply to "EXECUTIVE," Wm. Porteous and Co., Advertising Agents, Glasgow. P3412 A

WANTED, EXPERIENCED ELECTRICAL ENGINEER, to take active part in management of Old-established Business having large Marine connection. Excellent opportunity for party able to introduce £1000. Audited Accounts and all information available to bona fide enquirers.—Address, "ENGINEER," Wm. Porteous and Co., Glasgow. P3463 A

WANTED, YOUNG ENGINEER, Bachelor of Science, with workshop training, for POST in Calcutta.—Address, 6091, The Engineer Office. 6091 A

APPLICATIONS are INVITED for a POSITION in the SALES OFFICE of Samuel Pegg and Son, Quarry and Roadmaking Plant Builders. Applicants must possess experience of similar work. State salary required.—Address applications, "P" Department, SAMUEL PEGG and SON, Alexander-street, Leicester. 6099 A

SITUATIONS OPEN (continued)

AN Old-established Firm of English Manufacturing Engineers, specialising in an engineering commodity in very large immediate and prospective demand in India, contemplate erection of an Indian factory. A YOUNG ENGINEER REQUIRED, to train with view to management. Must be in position to take substantial financial interest. Exceptional opening for man of energy and character.—Address, 6028, The Engineer Office. 6028 A

CONSTRUCTIONAL STEELWORK.—RESIDENT ENGINEER REQUIRED to Take Charge of the Construction of large Steel-frame Building in London. Practical, technical and erection experience essential.—Address, stating same fully, with age, salary and when at liberty, P3472, The Engineer Office. P3472 A

CONTRACTORS' ASSIST., London. Building supervision essential.—Address fully, experience, and wages required, 3479, The Engineer Office. 3479 A

EXPERIENCED and Resourceful DESIGNER of Confectionery Machinery REQUIRED. State age and qualifications.—Address, P3471, The Engineer Office. P3471 A

METALLURGIST REQUIRED for Tube Works in Midlands. Qualified to undertake inspection of materials, heat treatment, and general laboratory work.—Address, stating age, experience and salary required, 6088, The Engineer Office. 6088 A

SECTION SHEETS.—WANTED, EXPERT who can PREPARE TABULATED SHEETS of GIRDERS, STANCHIONS, &c., for use amongst constructional steel buyers. State experience and remuneration required.—Address, 6114, The Engineer Office. 6114 A

STATION SUPERINTENDENT for South Wales Colliery Power Station. Total installed plant 10,000 K.W., A.C. and D.C.—Address, giving experience, salary required, &c., 6116, The Engineer Office. 6116 A

WANTED, a SENIOR DRAUGHTSMAN, with Good experience in the Motor Car Trade and with special ability in checking drawings.—Address, quoting references and salary required, 6095, The Engineer Office. 6095 A

WANTED for London Office, Good CONSTRUCTIONAL STEEL WORK DRAUGHTSMAN, one used to making Shop Drawings with minimum supervision.—Address stating age, experience, and salary expected, P3465, The Engineer Office. P3465 A

WANTED, Fully Qualified MECHANICAL DRAUGHTSMAN, with sound knowledge of design in Automatic Machinery. State age, salary required, and give full details of experience.—Address, 6046, The Engineer Office. 6046 A

CONSTRUCTIONAL STEELWORK.—JUNIOR, with Drawing-office and experience of Site Surveying, REQUIRED. State age, experience, salary and when free.—Address, P3473, The Engineer Office. P3473 A

DRAUGHTSMEN, Capable, WANTED, Thoroughly experienced in Ore Mining, Concentration and Metallurgical Machinery.—Apply to FRASER and CHALMERS ENGINEERING WORKS, Erith, Kent, stating experience, age and salary required. 6090 A

DRAUGHTSMAN, Competent man, to Take Charge of small Drawing Office of Constructional Engineers; accuracy in workmanship essential. Good opening for right man with experience. State age, salary and full particulars.—Address, 6115, The Engineer Office. 6115 A

DRAUGHTSMAN (Ex-Service), with Mechanical and Structural Steel-Work experience, REQUIRED AT ONCE. Knowledge of Photography desirable. Salary of £4 5s. per week.—Address, stating age and full details of experience, 6100, The Engineer Office. 6100 A

DRAUGHTSMAN (JUNIOR), with Pumping Machinery experience, REQUIRED for East Midlands. State experience, previous employers, age, salary required.—Address, 5997, The Engineer Office. 5997 A

DRAUGHTSMAN REQUIRED, with Experience of Laying-out Chemical Plant, Transmissions, Structural Steel Work. Must be a good Drawer and Tracer. State age, salary required and experience. London, N.W. district.—Address, 6111, The Engineer Office. 6111 A

EXPERIENCED MOTOR VEHICLE DRAUGHTSMAN WANTED in Midland district. State age and salary required.—Address, 6097, The Engineer Office. 6097 A

FERRO-CONCRETE.—K. HOLST and CO. have a VACANCY in their Drawing Office. Applicants, who must have a good Engineering Degree and at least three years' specialist experience, are invited to send full particulars, stating age and salary required, to 1, Victoria-street, S.W. 1. 6113 A

FIRST-CLASS REINFORCED CONCRETE DESIGNER WANTED IMMEDIATELY; must be thoroughly experienced.—Write, INDUSTRIAL CONSTRUCTIONS, Ltd., 44, Grosvenor-place, S.W. 1, stating age, experience, and salary required. P3469 A

SEVERAL FIRST-CLASS SENIOR and JUNIOR DRAUGHTSMEN REQUIRED for Aircraft Design. Technical training essential. Aircraft experience desirable but not essential.—State age, salary and experience, BOULTON and PAUL, Norwich. 6079 A

THE CHATWOOD SAFE CO., Ltd., REQUIRE the SERVICES of a well-trained MECHANICAL DRAUGHTSMAN. Speed, neatness and accuracy are essential qualifications to the appointment.—Replies, stating age, experience, and salary expected, should be addressed to "TECHNICAL DIRECTOR," The Chatwood Safe Co., Ltd., Shrewsbury. 6043 A

TWO DRAUGHTSMEN REQUIRED for Aero-engine Work. Must be accurate in their work and have had experience with well-known firms. Reply should state age and salary required.—Address, 6096, The Engineer Office. 6096 A

FIRST-CLASS VIEW ROOM FOREMAN REQUIRED. Only those who have held a similar position with high-class Automobile Engineers need apply. State age, experience, salary required.—Address, 6074, The Engineer Office. 6074 A

SITUATIONS WANTED

ADVERTISER, Aged 23, Hons. B.Sc. (Eng.), London, A.C.G.I., 2 yrs. workshop training, DESIRES SUITABLE POST, with prospect of advancement.—Address, P3474, The Engineer Office. P3474 B

AS TOOL ROOM or WORKS SUPERINTENDENT. Practical and energetic; age 43; free.—Address, P3452, The Engineer Office. P3452 B

ENGINEER SEEKS POSITION of RESPONSIBILITY. Wide experience at home and abroad with general, railway, constructional, manuf., administrative organisation and productive efficiency of approved ability.—Address, P3350, The Engineer Office. P3350 B

ENGINEER, Swiss, with 30 Years' Technical and commercial experience, good European connection, fluent English, French and German, at present in England, DESIRES responsible POSITION as Representative for English concern on the Continent.—Address, P3464, The Engineer Office. P3464 B

SITUATIONS WANTED (continued)

GENERAL or SALES MANAGER, Widely Experienced Mechanical Engineer (41), with considerable experience in the organising of an engineering sales force (home and export) and some years' experience of general management, is OPEN for ENGAGEMENT, London or provinces.—Address, P3475, The Engineer Office. P3475 B

POSITION WANTED as RESIDENT ENGINEER, Docks, Railways, Roads, Bridges.—Address, 5871, The Engineer Office. 5871 B

DRAWINGS, TRACINGS, Expeditiously PREPARED by Mech. Draughtsman, A.M. Tech. I. (Gt. Britain); 12 yrs. all-round exp. Mod. charges.—Address, 41, Wray-cres., N. 4. P3468 B

LARGE and Old-established FIRM of Constructional Engineers in India REQUIRE a thoroughly capable STRUCTURAL DRAUGHTSMAN. Age not over 25, unmarried.—Reply, giving fullest details education, engineering experience, present class work and present salary, to Box "Z.N. 783," c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 6102 A

MECHANICAL FITTER, TURNER, ERECTOR (27), tropical experience, public works, construction, erection and maintenance of oil engines and plants, concrete jobs, conversant Spanish language, perfect health, DESIRES POST, home or abroad, any capacity; good education, willing worker, splendid references.—Address, "A.," c.o. Smiths, Liskeard. 6101 B

PARTNERSHIPS

IF YOU ARE SEEKING

A PARTNER or PARTNERSHIP

or wish to buy or sell a

BUSINESS or WORKS

Write:

WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
London, E.C. 4.
Established over 75 years.

If you wish to purchase or sell a Business connected with the Engineering or allied Industries consult:

HENRY BUTCHER, HALL & CO.,
63 & 64, CHANCERY LANE,
LONDON, W.C. 2.

PARTNERSHIP.—An OPPORTUNITY OCCURS for a capable engineer with practical and commercial experience to REPLACE a RETIRING PARTNER in a firm with a fully equipped works manufacturing a speciality which is patented in all the principal countries of the world. Capital required £2000 to £3000. Every investigation given and references required. The applicant must be competent to manage the business.—Address in confidence, 6118, The Engineer Office. 6118 C

EDUCATIONAL

CORRESPONDENCE COURSES for Inst. Civil Engineers, Inst. Mech. E., London Univ., and ALL ENGINEERING EXAMINATIONS, personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Engr., London, Assoc. M. Inst. C.E., Chartered Civil Engineer, M.R.S.I., F.R.S.A., &c. Excellent results at all Exams., comprising hundreds of successes. Courses may commence at any time.—Apply to Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), A.M.I.C.E., &c., 8/11, TRAFFORD CHAMBERS, 58, SOUTH JOHN-STREET, LIVERPOOL. Tel. No., Bank 1118.—London Office: 65, Chancery-lane, W.C. 2. Ex. B

AGENCIES

CHARTERED CIVIL ENGINEER (39). Established in practice in South Yorkshire, would LIKE to GET IN TOUCH with ANOTHER similarly situated with a view to covering a wider field and for eventual amalgamation of interests.—Address, P3477, The Engineer Office. P3477 D

CONTINENTAL PLANT and SWITCHGEAR MANUFACTURER DESIRES Engaging ACTIVE AGENTS, positive business getters, preferably established firms, for district representation in British Isles, but excluding London, South Wales and North-East Coast. State full particulars of organisation available, engineering travellers, connections, terms, &c.—Address, P3461, The Engineer Office. P3461 D

MANUFACTURER'S REPRESENTATIVE. Connection amongst Midland engineering concerns, especially motor car manufacturers, WISHES to ACT for first-class FIRM (Steel, Metals, Frames, Wheels, Springs, Tubes, Tools, &c.) upon salary and/or expenses and commission.—Write, "REPRESENTATIVE," Norham Lodge Hotel, Leamington Spa. P3467 D

SIDE LINE.—Travellers Calling Upon Users of Steam Plant app. in confidence, F. S., 171, Maida Vale, London, W. 9. P3470 D

MISCELLANEOUS

AUTHORS DESIRING PROMPT PUBLICATION of their WORK should forward same to Messrs. ARTHUR STOCKWELL, Ltd., 29, Ludgate-hill, London. Established 29 years. Advice free; 24-page booklet of Press commendations on application. 5810 I

FOR HIRE

APPLY to RICHD. B. BATCHELOR, ARTESIAN WELL & CONSULTING ENGINEER (WATER SUPPLIES EXPERT).

All equipments for improving your Water Supply Largest Well Boring Plant, 3in. to 9ft. diam. Every description of Pumping Plant.

73, Queen Victoria-st., E.C. 4; & Chatham.
'Phones: Central 4908; Chatham 71.
Wires: Boreholes, London; Watershed, Chatham.
ESTAB. OVER 150 YEARS.

FOR SALE or HIRE, ELECTRIC MOTORS, from 60 to 300 H.P.; PORTABLE STEAM ENGINES, from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. T. WILLIAMS and SONS, 37, Queen Victoria-street, London, E.C. Tel., City 3938. Ex.

FOR HIRE, PUMPS and WELL-BORING TOOLS for Trial Borings and Deep Wells.—R. RICHARDS and CO., Upper Ground-street, London, S.E. Telephone No. 0978 Hop. S22 E

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

London's Record Rainfall.

THE severe two hours' downpour under which the Metropolis suffered on July 11th led to numerous cases of flooding and to many complaints regarding the insufficiency of the London drainage system to deal with the storm water. Commenting on the complaints received, the London County Council's Main Drainage Committee remarks that no financially practicable system of drainage could have disposed of the water in such a way as entirely to have avoided flooding. In the boroughs of Hammersmith, Fulham, Hampstead, Kensington and parts of Wandsworth, more than a million tons of water fell inside the two hours. This downfall was equivalent to the discharge of a river 100 yards wide and 4ft. deep flowing at 3 miles an hour and represented twice the capacity of London's eight main outfall sewers. At ten stations the fall exceeded 2in. per hour, including the remarkable figure of 5in. an hour in Balham High-road. There is no record of a previous rainfall in London of such intensity lasting for so long a period. It was fortunate that when the storm began the tide in the river Thames had been falling for some hours, and, as a consequence, the tidal outlets of the Council's sewer were available. Large quantities of water were discharged into the river through these outlets. Further large quantities were disposed of by storm relief works constructed at a cost of £2,500,000. Nevertheless, much flooding occurred. Many sewers became gorged with water, and the street and other gullies were insufficient to pass it at the rate at which it fell.

French Naval Construction.

THE credits to continue the programme of naval construction during the coming year were not voted by the French Parliament before its adjournment. This fact may have no connection with the meeting of the Naval Disarmament Conference at Geneva, and the delay in voting the necessary funds may be attributed to financial or other reasons. Nevertheless, the failure to vote the credits means that the laying down of the new batch of vessels will be retarded probably by another six months. It is pointed out that this delay will cause serious inconvenience to shipyards and to engineering firms which were preparing to receive contracts that would have prevented any interruption of work. Another cause of complaint is that in the event of an agreement being come to at Geneva, France and other Powers will be invited to accept a limitation of cruisers and light craft, and it is argued that France would find herself in a stronger position than she is now to claim a higher ratio if a large number of cruisers were under construction. The French will not consent to their ratio of cruisers and light craft being reduced to the same extent as prescribed for capital ships. As the second greatest colonial Power, France claims a sufficient number of cruisers to insure adequate protection on the colonial sea routes. In this respect she approves of the arguments put forward by the British delegates at Geneva, for both countries have the same reason for maintaining a strong fleet of light vessels. If the Geneva Conference should end satisfactorily the difficulties will be by no means overcome, for the French affirm their determination not to accept any further limitation of naval armaments, unless it forms a part of a general scheme of limitation to include land and air forces.

Wages in the Engineering Industry.

IN April, 1924, the various unions connected with the engineering industry submitted to the employers a demand for an all-round wages increase of 20s. weekly. Since that date thirteen national joint conferences have been held to discuss the subject, and on several occasions it seemed as if it would be quite impossible that the opposite sides would ever arrive at agreement. The dispute was, however, conducted throughout with much moderation and understanding on both sides, the employers freely recognising the low rates of pay prevailing in the engineering industry, and the unions equally recognising the grave condition of trade which the employers had to face. On Friday of last week, July 22nd, the long dispute was brought to an end. On that date, at a meeting between the representatives of the employers and the unions, Mr. J. T. Brownlie, president of the Amalgamated Engineering Union, reported that the union members had voted in favour of accepting the employers' offer of an increase of 2s. per week to all plain time workers over the age of twenty-one years. The ballot figures revealed a vote of 81,575 for acceptance and 41,527 against, showing a majority of nearly two to one in favour of acceptance. The increase is in the nature of a special bonus which is to be added to and be subject to the same conditions as the existing war bonus of 10s. per week. It will not be paid to workmen employed on any system of payment by results, or to those whose wages fluctuate in accordance with the wages of workpeople in other industries. About 50 per cent. of those engaged in the engineering industry will be excluded from the award under this restriction. The advance will benefit 165,000 workers in the shops of federated firms, and will be of particular benefit to the lower paid day-wage men. The advance will come into operation on and from August 1st.

Bridging the Bosphorus.

IN order to provide a direct link between European Turkey and Anatolia, schemes are now being investigated by a commission of railway experts and industrial and commercial representatives, acting under the Turkish Ministry of Public Works. The schemes proposed contemplate the construction of a suspension bridge over the Bosphorus, or, alternatively, the driving of a tunnel beneath it. The tunnel scheme is reported to be the most generally favoured, and it is stated that it will probably be adopted. Turkish capital is said to be available to provide part of the financial resources required. It is anticipated that the balance will be secured from certain German financial and industrial undertakings with whom the contract for the work would be placed. The contract would include the driving of the tunnel and the construction of an electric railway through it.

The First Sea Lord.

TO-MORROW—July 30th—Admiral of the Fleet Earl Beatty lays down the office of First Sea Lord, which he has held for nearly eight years. His appointment took effect on November 1st, 1919, and a search through the naval records reveals no parallel to this prolonged spell of service as professional head of the Navy. Far-reaching changes have taken place during his administration. The Fleet of to-day is a mere shadow of what it was eight years ago. Under the combined influence of economy and the Washington Agreement, the establishment of both material and *personnel* has been more than halved. Whole battle fleets and cruiser squadrons have disappeared. On the other hand, our present Navy, limited though its dimensions may be, has been brought up to a very high standard of technical efficiency. The country owes a debt to the retiring First Sea Lord on two counts. Having discharged the arduous and painful task of reducing the world's mightiest war machine to a peace footing, he was faced with the still more difficult duty of arresting the process of wastage which at one time threatened to undermine the very foundations of our naval power. It was entirely owing to his personal influence that the Labour Government of 1924 was induced to sanction the laying down of our first group of post-war cruisers, and again in the following year his efforts were instrumental in securing the adoption of the five-year replacement programme which is now in train. The only blot on his administration was his treatment of the engineer officers of the Navy, of which the last has by no means been heard. Earl Beatty's successor at Whitehall is Admiral of the Fleet Sir Charles Madden, an officer who commands the entire confidence of the Service.

A Strike Against High Wages.

THE peculiar strike against high wages which began on July 13th at the works of John Wright and Co., Ltd., gas cooker and gas fire manufacturers, Aston, Birmingham, has now been brought to an end. The Ironfounding Workers' Union sought to impose the sum of 23s. 6d. per day as the maximum limit of the wages to be earned by any of its members. One man earned 1s. 9d. per day in excess of that figure, and to enforce the restriction 450 of Messrs. Wright's workers came out on strike. Work was resumed on Monday of this week on the basis of an agreement arrived at on the 23rd. The agreement was signed by the chairman of the management board of the Engineering Employers' Federation, by a member of the firm, and by two representatives of the union. It expresses recognition of the fact that the strike of the moulders was caused by reasons for which the company was not responsible, and agrees that no restriction shall in future be placed on individual output or earnings. The agreement also makes provision for avoiding disputes in general. It specifies that when a question arises an endeavour shall be made to settle it by the management and the workman directly concerned. If no settlement is arrived at the company, on request, undertakes within seven days to receive a delegation from the trade union. If the delegation is accompanied by an official representative of the union, the presence of a representative of the employers' association will be permitted. Until this procedure has been carried out there is to be no strike, either of a partial or general character.

Thames Bridges.

DUE and proper consideration is being given to the recommendation made by the Royal Commission on Cross River Traffic that a bridge with its approaches should be constructed at Charing Cross to carry the Southern Railway Company's lines as well as a roadway. The cost of the scheme has been roughly given at £12,000,000 to £13,000,000. The project, according to a reply given in the House of Commons on Tuesday by the Minister of Transport, is now being actively inquired into by Messrs. Mott, Hay and Anderson, the consulting engineers, in conjunction with Sir George Humphreys, the chief engineer to the London County Council, and Mr. A. W. Szlumper, late chief engineer to the Southern Railway. It is anticipated that the consideration of the scheme will extend over a number of months yet. Meanwhile, there seems to be no grounds for the alarmist reports that Waterloo Bridge—the old stone structure—is suffering rapid and serious subsidence. According to a statement made before a meeting of the London County Council, the bridge is being kept under constant observation, and no change endangering the safety of the structure has been observed during the past year. A year ago, in addition to the serious subsidence at pier No. 4, there had occurred a settlement of 11in. and 7in. respectively at piers Nos. 3 and 5. The temporary supports, it is stated, are now maintaining the bridge sufficiently well to remove any cause for anxiety. During the current financial year the Council, it is estimated, will have to expend about £12,000 on the maintenance of the bridge.

The Trade Disputes Bill.

ON Monday of this week, July 25th, the third reading of the Trade Disputes and Trade Unions Bill was moved in the House of Lords by Viscount Peel, First Commissioner of Works. Lord Gorell moved an amendment for the rejection of the Bill, but, on a division, the amendment was defeated by 86 votes to 17. The Bill was thereupon read a third time and passed. Up to the last moment criticism continued to be heard regarding the definition of the circumstances under which a strike is to be regarded as being illegal according to the intentions of the Act. According to the definition given in the Bill a strike against which the provision of the Act will operate is a concerted refusal to accept employment if such refusal is for other than an industrial object and designed to coerce the Government. Viscount Cave, speaking on the occasion of the third reading of the Bill, presented the case for it with admirable brevity. He said that the measure was Parliament's answer to the attack on the State embodied in the general strike. There had been little hope of the trade unions dealing with the matter themselves, and, in any event, it was desirable to have a substratum of law around which custom and practice could be framed. If it were administered in a spirit of wisdom and moderation he felt confident that in years to come the measure would be regarded as their charter by many of the country's workers.

Railway Bridge Reconstruction.

WHILE the principal share of the public attention drawn to the developments on the Southern Railway during the past three years or so has been concentrated upon the electrification of the suburban lines and on the construction of a new fleet of powerful locomotives, the work carried out in the background, of strengthening the bridges on the South-Eastern and Brighton sections, deserves attention by reason of its operational importance and its engineering significance. The new locomotives of the "King Arthur" and other classes were essential for the improvement of the main line services. Before they were built some of the most important trains on the company's system were being handled by two engines, while for others "Atlantic" engines built in 1905 were the best available that could be used. In 1924 there was not a main line on the South-Eastern or Brighton section that could bear the weight of the new engines. It was therefore decided to expend a sum of £250,000 on the strengthening of all the main line bridges other than those on the South-Western section, which were already strong enough to support the increased loads. During the past three years over a hundred bridges have been strengthened in accordance with the plans made in 1924. The programme of work, with the exception of a small section of the line to Margate, has now been completed, with the result that heavy engines can now be run on any main line of the system from Kent to Cornwall.

Automatic Telephones in Ireland.

AN interesting event illustrating the progress of telephony in the Irish Free State occurred at 2 a.m. on Sunday morning, July 24th, when in the presence of the President, Mr. Wm. T. Cosgrave, the Vice-President, and the Postmaster-General, 700 lines of the first public automatic telephone exchange in Ireland were cut-over into service. This event took place at the Ship-street Exchange, Dublin, and the installation represents the first portion of an automatic network—similar to that now being installed by the British Post Office—to come into service. A further exchange known as Merrion will be opened in the autumn. The whole contract is in the hands of Standard Telephones and Cables, Ltd., and the apparatus is being manufactured in its entirety at the company's Hendon factory.

An American Diary.

No. I.

IT is a mistake to make too long a visit to America. If a liquid parallel may be drawn with a dry country, the first bottle clears the brain, the others confuse it. In ten days one may know a great deal about the United States. He may know why they are prosperous, why they use powdered fuel, why they pay high wages, why they are "dry," why you may be laundered in twelve hours—which so impressed Austin and Lloyd—why Mr. Ford is not popular, why high-pressure-high-temperature steam causes no trouble, and why Babe Ruth gets 75,000 dollars a year for playing "the game." He may know the answers quite positively to a great many difficult technical questions, may know the latest views of America upon education, and may have learnt all that there is to be learnt about Labour and Capital, the open shop, the instalment plan, the passing of the boom, and the operation of Federal Reserve Bonds. All these things and many more one may know in ten days. Then is the time to write a book.

Tarry another ten days, and the ignorance which makes knowledge easy passes for ever. Certainty begins to shiver upon its foundation. Positive facts begin to stand less firmly on their feet. Doubts begin to assail the conscientious inquirer. The pen that ran so freely, halts and splutters upon the paper. . . . Take another ten days, and you may draw a red-ink line through all your precious observations. You find you know nothing—but one thing, that America is just as much in doubt about the technical problems of to-day as Europe is, that she really does not know why she is prosperous, is hazy about education, does not really pay high wages, is not free from labour troubles, is not convinced that it is better to be wet or dry, does not know whether the instalment plan is a success or failure, and is not sure that Babe Ruth is really "it."

This diary covers a period of a trifle over five weeks. In those five weeks twelve cities were seen, hundreds of people were pestered with questions, a dozen or more great power stations were inspected, and in four or five universities debates upon the education of engineers were held. Hurried inspections were made of research laboratories, the engineering of great buildings were studied, theatres and picture galleries and museums were visited, and a few not to be forgotten days were spent with the American Society of Mechanical Engineers at White Sulphur Springs, which is in West Virginia amongst old trees, hills where "the morn, in russet mantle clad, walks o'er the dew," brooks, wind-lapped waters—and three golf courses. He who would do the same must know George Orrok of New York—"Uncle George," to his friends—the best host, the best *cicerone*, that man ever met. He may go, if he will, prepared to detest America, all her ways and all her people; if he has any human blood in him at all, the capacity to enjoy a good story and eat a good meal—for the Americans are hearty eaters—make the best of iced water, listen with both ears and ask questions with both sides of his tongue, then before he has been twenty-four hours upon the free—within strict limitations—land of America he will have changed his view and come to the conclusion that he ought to have known his cousins better long ago, and find himself pondering upon the enormous possibilities of the Union of the English-speaking Nations of the World. America is no place for the atra-bilious, the pessimist, the envier, the little-thinker. He will hate it. But let one have but a reasonable modicum of the human in his composition, an ardent desire to know, a readiness to talk, and, above all, to listen—your American likes to talk about himself and his works—a constitution which can stand long night journeys, and a delicacy which is not offended by the familiarity of American sleeping cars, and if, being also an engineer, he fails to enjoy himself in America, then he must meet very different people from those which were encountered on the passage recorded in this diary.

* * *

It started badly; that must be confessed. After a perfect voyage in a ship that meets the heart's desire—the Minnetonka—anchor was dropped off Quarantine at two minutes past half-past seven of an April evening, with a warm wind blowing from the city, and friends waiting on the quay a few miles up the river. But Quarantine doctors are State officers. They have their exits and their entrances controlled to the second. We were two minutes after closing time. Morse signals flashed impatiently from ship to shore. The shore replied with twinkling dignity that the Doctor's car was at the door and he was off home to dinner. The ship and her impatient passengers might go to Jericho, for all he cared. His clam-chowder was getting cold; nothing would induce him to desert his home at that scandalous hour of night. If, however, the ship chose to wait where she was till six o'clock next morning, he would be pleased to come on board and see what could be done. So there we were, all dressed and packed for the shore, with all the stewards standing at attention in a row like soldiers, and no one to give us our permits to land on American soil. And there we had to stop all night, whilst a peremptory sky-sign ordered us at intervals of fifteen seconds to chew a particular sort of gum, and we combined in one all-embracing vow that if ever we chewed gum, which God forbid, we would not chew *that* gum. Which shows that the right place for advertisements is in newspapers and the wrong place the neighbourhood of an impatient shipload of people.

Well, that was soon a thing of the past and forgotten, and if it showed that not even American efficiency is perfect, it was offset a day or two later by the enterprise of the Pennsylvania Railroad Company, which sent a plenipotentiary to the office to make all the final arrangements for travelling, supply the necessary tickets, and collect the money. But that is to anticipate, for there was much to be done and much to be seen in New York itself before the journey began. And to put everything in its order, let us record a visit to the wonderful United Engineering Societies' building, which Carnegie's generosity made possible, where many engineering societies are accommodated, several with a whole floor apiece, and where there is a theatre almost like a real theatre, a common library, and all facilities for the physical as well as moral affiliation of learned bodies. Then next door is the Engineers' Club, where all the engineers of America foregather, and where, in an upper chamber, the technical Press of New York made us welcome at a friendly luncheon and openly discussed problems which are not for those outside the brotherhood of the Press. Surely, the cordiality of that welcome was the sample and God's-pennie of what was to come. And so, having made many acquaintances and some friends, and shaken hands with men whose names echo in the engineering of the world, to the duties of the trip and a visit to the first of the many power stations that were inspected.

It is no easy matter to drive from the hub of Manhattan to Hell Gate; it is no easy matter to drive anywhere in New York. There is one automobile (*Anglice* motor car) to every five persons in America, but in Manhattan there are, at a guess, five cars to every person! The density of traffic is twice that of London; think of Piccadilly at theatre time and you have New York all day long. Movement is as slow as roses in a dry spring. Were it not for an excellent control system, it would be impossible. Where all the side streets debouch into the great avenues there are three lamps, which can be lit at the pleasure of a controller perched in a central tower. One is red and stops all longitudinal traffic, one yellow for caution, and one green for "go." The man perched in his tower, from which he can see half a mile up and down the avenue, switches on one or other of the signals at every block all the way to the next tower. Thus by the pressing of a button he stops all the traffic along the avenue and allows the cross streams to flow. Then with another button he turns on a mile or more of main vehicular current again and holds up the transverse streams. The aeroplane looks down upon Fifth-avenue and sees the traffic split into plugs like the bubbles in a Sprengel's air pump, moving jerkily from block to block. It is magnificent, but tedious; one travels with the uneasy gait of a looper caterpillar. But the roads are good, the "cabs" are comfortable, the fares are reasonable, your companion is George Orrok—a veritable encyclopedia—and you get there in time pleasantly enough.

HELL GATE.

Hell Gate is on the river. All American steam power stations are "on the river" or its equivalent. The reason sticks out a yard. Allow ten gallons of circulating water for every pound of steam, and ten pounds of steam for every kilowatt-hour, and one hundred thousand kilowatts to the station. That gives you nearly ten million gallons of water per hour, 240 million gallons every twenty-four hours—nearly as much as the water supply of Greater London! Now, 100,000 kilowatts is not a very big power station. Hell Gate is approximately three times as great. Hence it is manifest that it could only be placed on a river, and a big river at that. As a matter of fact, the ultimate capacity of Hell Gate is 335,000 kilowatts, and the circulating pumps have a capacity of nearly 2 gallons per minute per kilowatt. One does not need Gerbers' brazen head to see that, at a 100 per cent. load factor, nearly one thousand million gallons of water would pass through the pumps in twenty-four hours. When someone discovers how to condense steam without circulating water, how much simpler a power station will be! But that is another story. In any case, cooling towers, which may do for some little stations, are unthinkable when you come to these mighty power-houses.

"Hell Gate" takes its name from a channel at the entrance to Long Island Sound in the borough of the Bronx. Coal comes to it by the river and is snatched out of the barges by two 2-ton clam-shell grabs on travelling towers, which whip it up a hundred and fifty feet or so into the air and drop it into grinders; it then travels horizontally across the top of the station in 4-ton cars and is dumped into bins from which it ultimately enters the feeding hoppers of the boilers. The grabs make two round turns per minute, and if they could work full bore all the time would empty a 5000-ton barge in about ten hours—the actual record is fifteen hours.

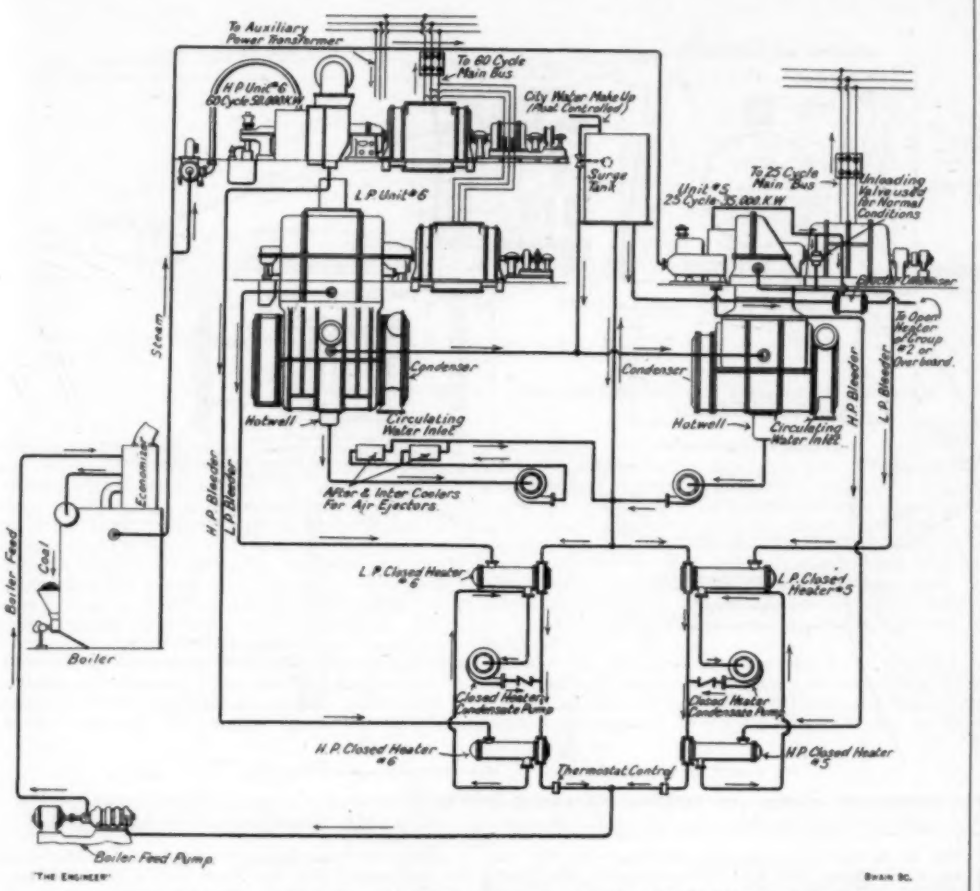
Hell Gate has been described often. It was once a star turn; "featuring Hell Gate" was common on the bills. But it is beginning to get *passé;* it has been in the limelight for nearly six years, possibly half the allotted span of American power stations. As you may tell the age of a tree by its annual rings, so you may tell the age of Hell Gate. It started with a "stunt." Construction began in March, 1920, and in November, 1921, "juice" was delivered from two main turbines, each of 35,000 kW capacity. Two months later two more units, one of 35,000 and one of 40,000, were completed; then in 1923 yet another of the larger size took up duty, and in each of the two succeeding years a unit of 50,000 kW was added, the total capacity last year being actually 285,000 kW. The last turbine, another of 50,000, is nearly complete, and the total plant-kilowatts will then reach 335,000. The guaranteed water rate—or steam consumption as we should call it—is round about 10.5 for the turbines at best load.

It is in the boiler-rooms of power stations that novelties are to be sought. Turbines and generators change but little; they grow bigger and bigger, they have to take higher and higher pressures, they are bled, they are Baumannised, they have their problems of erosion and corrosion; but the more they change, the more they are just what they always were—star-wheels in a box, revolved by the impulse or reaction of steam. Not much to look at in any case, and unless you have your stethoscope stuck into the arm-hole of your waistcoat, the most you can do is to lay your hand learnedly upon the casing and say sagely that you feel no vibration.

> "Not prying Argus could discern the rest,
> Yet might the observing eye of things concealed
> Conjecture safely, from the charms revealed."

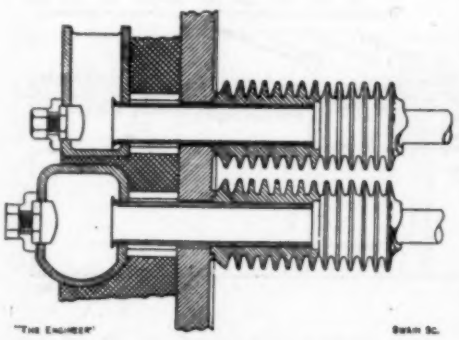
That was said of a lady many long years since, but 'twill pass well enough for a turbine of to-day. If you go below and "get on to condensers," you may find more of interest, as we shall see anon. But the modernity of power stations is in the boilers. Pry into their inwards and their outwards, see how small a part is now the actual "boiler" itself, consider the air pre-heaters, the superheaters, the reheaters perchance, the firing arrangements, the control system, the water walls, the fans for providing primary and secondary air, and the hundred and one other things that are needed to complete a modern boiler, and at every turn you will see changes, modifications, developments, novelties; you will hear of difficulties, of bitter experiences, of aspirations, of forebodings—the last because there are those who see the time when the present colossal structures will be replaced by generators no bigger relatively than a pill-box to a boy's school-chest. All the boilers at Hell Gate are Springfields for 275 lb. gauge pressure. It is interesting to look at some of the ratios. In the first, 1921, there was 1·51 square feet of water-heating surface per kilowatt installed; later, that figure fell to 1·36; still later, when the first 50,000 kW unit went in, it dropped to ·75. But the ratio of furnace volume to water-heating surface rose from 0·423 in the original installation and 0·41 in the No. 5 unit, to 0·518 in the 50,000 units. It must be remembered that Hell Gate has stokers,

not powdered fuel burners. The original boilers have a stoker at each end, and the grates form a very obtuse vee; the furnaces have refractory walls. The later boilers are single-ended, and have water side walls. The first boilers, twelve in number, 1890 H.P. each, are simple affairs. They have no economisers. The superheaters are intermediate between two banks of generator tubes. They are composed of bent tubes connecting two drums. The tubes reach half-way across the boiler sideways. As there is a group at each side, the space is filled. The first row of tubes is 21ft. above the furnace at one end and 16ft. at the other. The 1923 boilers, three



"HEAT BALANCE" LAY-OUT FOR UNITS 5 AND 6 AT HELL GATE POWER STATION

in number, are of 1590 H.P. They have water walls (400 square feet), economisers and a different kind of superheater. It is placed at the top and runs parallel to the generating tubes. Each element is composed of two U-shaped steel tubes, 2in. in diameter; the two tubes are connected in series and form a continuous loop. An interesting feature is that on the outside of them is fitted a series of tightly fitting cast iron gilled rings. Here is a



PART OF SUPERHEATER ELEMENT

little section which shows the arrangement. It is worth noticing that all the joints are external. The economisers are right on top of the boilers. The elements are straight steel tubes, expanded into cast steel return headers, and they also are provided with the cast iron gill rings. In still later boilers the economiser is different; it has lead alloy-coated steel tubes, and has two gas passes. The superheater is nearly the same as before, but is more nearly horizontal. In the latest boilers it is quite horizontal, but between the upper and lower headers the tube makes five bends instead of two. A few more interesting figures to show the direction of progress. The superheating surface began at 2135 square feet for the total water heating surface of 18,900 square feet; it rose to 7410 square feet for a water surface of 15,900 square feet; then to 10,450 square feet for a water surface of 12,560. The boiler pressure is constant at 275 lb., but the superheat has been raised by 50 deg. from 200 deg. to 250 deg., and the total temperature from about 600 deg. to 650 deg. The economiser surface has remained constant with a ratio to evaporating surface just a little below unity.

It is not proposed to say much about the generators. The first to be put in were single-cylinder impulse units—Curtis—developing 35,000 kW, and were made by the General Electric Company; then came two tandem compounds by Westinghouse, developing 40,000 kW; and finally two cross-compound units of 50,000 kW, also by Westinghouse. The first three generators are three-phase, 25-cycle, 11,400-volt machines; the remainder three-phase, 60-cycle, 13,200-volt machines. To tie together the two frequencies, a 35,000-kW frequency changer is installed. The diagram which is reproduced above is full of interest, but must be left to speak for itself. It is what they call in America the "heat balance" lay-out, and it shows the steam and other circuits for units 5 and 6.

Despite its great age—nearly six years!—Hell Gate is still one of the show stations of America, and the impression it leaves upon the mind when it forms an introduction to super-power stations is that of enormous size. It is, moreover, as these notes may in some degree have dimly indicated, a remarkably interesting station, and if it were not that more modern stations—stations with 350 lb., 500 lb., 600 lb., 1200 lb. pressure—are waiting to be visited, it would be pleasant to spend pages discussing it.

(To be continued.)

The Tâf Fechan Reservoir and Works.

No. I.

On Thursday of last week, the 21st inst., the new Tâf Fechan Reservoir and its accessory works were formally put into service by Lord Buckland. This reservoir has been constructed to provide additional supplies of water to the large area in South Wales, which is shown on the accompanying sketch map—Fig. 1—and which, as will be seen, includes the county borough of Merthyr Tydfil. When full, the reservoir will contain 3400 million gallons of water and will constitute a lake having a surface area of 349 acres.

Before going on to describe the embankment which forms the reservoir, and the various works which go to make up the full scheme, it will be of interest perhaps if we give a brief outline of the events which preceded the decision to construct them. It will be observed that in the catchment area of 8351 acres, which is shown at the top of Fig. 1, there are four reservoirs, namely, the Upper and Lower Neuadd reservoirs, the Pentwyn reservoir, and the Tâf Fechan reservoir. Of these, the first to be formed was the Pentwyn, which was built under an Act obtained in 1858 by what was then the Merthyr Local Board of Health. It contained 346,000,000 gallons, had a top-water level of approximately 1080ft. above O.D., and a surface area of 96¼ acres. Owing to the fact that a geological fault occurred below the site of the embankment, there was continuous trouble from leakage almost from the time that the dam was built, and considerable sums of money were spent from time to time in the endeavour to stop the flow of water. Into the details of these repairs it is not necessary for us to enter here. It will only be necessary to say that they had to be continued till a recent date.

Comparatively early, it was realised by the Board of Health that this reservoir would not, for long, satisfy the growing needs of the district. Moreover,

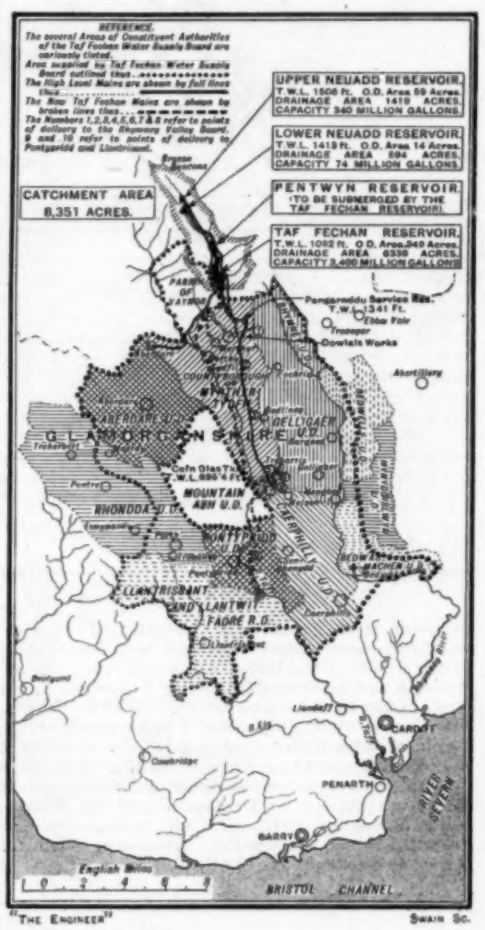


FIG. 1—TÂF FECHAN WATER BOARD SUPPLY AREA

it did not stand at a sufficient altitude to permit of all portions of the area being supplied by gravity. Accordingly, the Lower Neuadd reservoir was constructed under a Provisional Order which was confirmed by an Act passed in 1876. It has an available storage capacity of 74,000,000 gallons and a top water level of 1413 O.D. Prior to its construction, the high parts of Dowlais had to be supplied by pumping, but for some years after it was put to work, Dowlais and other points of high altitude could be supplied by gravity. A still higher reservoir, the Upper Neuadd was built by the Merthyr Urban District Council—as it had then become—under an Act obtained in 1895. Its top water level is 1506·5ft. above O.D., and it has a capacity of 340 million gallons. It is formed by a masonry dam, founded on the old red sandstone, and 1410ft. long measured along the parapet. It was designed by the late Dr. George F. Deacon, M. Inst. C.E., and built under his directions, with Mr. Thomas F. Harvey as resident engineer. It is a good example of an economically designed structure.

As a matter of fact, the reservoir is very small in relation to the extent—1419 acres—of its catchment area, which lies immediately to the south of the Brecon Hills, where the rainfall is much heavier than it is further south. As a result, the reservoir during the wet months of the year is full and often overflowing.

Even when this reservoir was completed it was soon realised that the supply from all three reservoirs would rapidly become insufficient to meet the constantly growing demand, both from the borough of Merthyr itself and also from the Authorities in the

surrounding country which depended upon this source. The matter was of all the greater importance in view of the fact that, in spite of the operations carried out to lessen it, the leakage from the Pentwyn reservoir continued on a constantly increasing scale. Accordingly steps were taken during the years 1906–7 to ascertain whether it were possible to construct a larger impounding reservoir within the existing catchment area. Trial bore-holes were put down to the northward of the Pentwyn embankment to find out whether it would be possible to choose a line for a dam that would avoid the fault of which mention has already been made. It was found, however, that the depth of the glacial drift above the old red sandstone was much deeper than had been anticipated. In the middle of the valley, for instance, a bore-hole was sunk to a depth of 130ft. before rock which would give a water-tight foundation was reached. Finally, it was ascertained that some 2 miles south of the Pentwyn embankment there was a site on which a reservoir dam could be more economically constructed.

Detailed surveys were then made and parliamentary plans were prepared by Dr. Deacon and Mr. Harvey, and in November, 1907, a Bill was deposited in Parliament in which the Merthyr Corporation sought for powers to construct the Tâf Fechan reservoir, and to lay a pipe line to the southern boundary of the county borough at Abercynon, the estimated cost for the work being £350,000. The work which was proposed in the Bill was identical with that which has actually been carried out, saving that the embankment would have been 3ft. lower than the present structure. Had the Bill passed, the necessary money would at that time have been borrowed for 3½ per cent., but unfortunately it was very strongly opposed and did not come before Parliament.

Some three years later, various authorities in the Rhymney Valley, which were being supplied in bulk by the Merthyr Corporation, applied to Parliament for powers to construct a reservoir identical with the Tâf Fechan reservoir, as proposed by Merthyr. The latter also deposited a Bill re-introducing its 1907 scheme, and in the event, the Merthyr Bill was passed, and the Act of 1911 empowered the Corporation to construct the Tâf Fechan reservoir works. The engineer's estimate, which included the cost of acquiring the necessary land, was rather less than £400,000.

The scheme provided for the construction of an earthen embankment, 1010ft. long and 107ft. high, with a puddle clay core. The task of carrying out the work was entrusted to Sir Alexander Binnie, Son and Deacon, of Westminster, and Mr. Thomas Fletcher Harvey—who, as mentioned above, was resident engineer during the building of the Upper Neuadd dam—as joint engineers. As the result of putting the work out to tender, the contract for the construction of the new dam was awarded to Sir Robert McAlpine and Sons in 1913. A certain amount of work was done before and during the early period of the war, but as a result of circumstances brought about by the hostilities, the contractors ceased work in 1917. When it became possible to resume operations they were continued, and were finally terminated, by direct administration.

Meanwhile, the discontinuation of constructional work made it necessary for the Merthyr Corporation to apply for an extension of time for completion, and, incidentally, for increased borrowing powers in consequence of the enhanced cost of materials and labour as the result of the war. The necessary permission was obtained in the Act of 1920. The following year, both the Merthyr Corporation and the Rhymney Valley authorities promoted a Bill with the same object, namely, the creation of a Joint Board to take over the whole waterworks undertaking. The Bill of the Rhymney Valley authorities was passed, and by their Act of 1921 the Tâf Fechan Water Supply Board was duly constituted. The undertaking was formally taken over on April 1st, 1922, and it is under the new Board that the dam and its ancillary works have been completed.

As already stated, and as shown in Fig. 1, the Tâf Fechan reservoir comes directly to the south of the Pentwyn reservoir, and it will, when full, have a top water level of 1082ft. above O.D., or 1·6ft. higher than the latter, which will, in fact, be absorbed and form part of the new lake. The combined length of the two stretches of water at top water level will be 2¼ miles, and the combined area 349 acres.

We may mention, in passing, that the available combined yield of the Board's three reservoirs—for as the Pentwyn reservoir will be merged in the Tâf Fechan it will cease to have a separate entity—will amount to 16,000,000 gallons a day, after making allowance for three consecutive dry years and after deducting compensation water. Of the total, the two Neuadd reservoirs will contribute one-quarter, or 4,000,000 gallons per day. The Act provided that a certain limited volume of compensation water should be discharged into the river during the progress of the works, and that, after their completion, the amount of compensation water sent down should be 6,835,000 gallons per twenty-four hours. We may add that the annual rainfall over the whole catchment area of 8351 acres averages 69½in. The capacity of the new reservoir will be nearly, though not quite, large enough to equalise the flow, not only from its own catchment area of 6338 acres, but also from those of the two upper reservoirs, *i.e.*, 1419 and 594 acres respectively. In any case, however, it is as large as it was feasible to make it having regard to the level

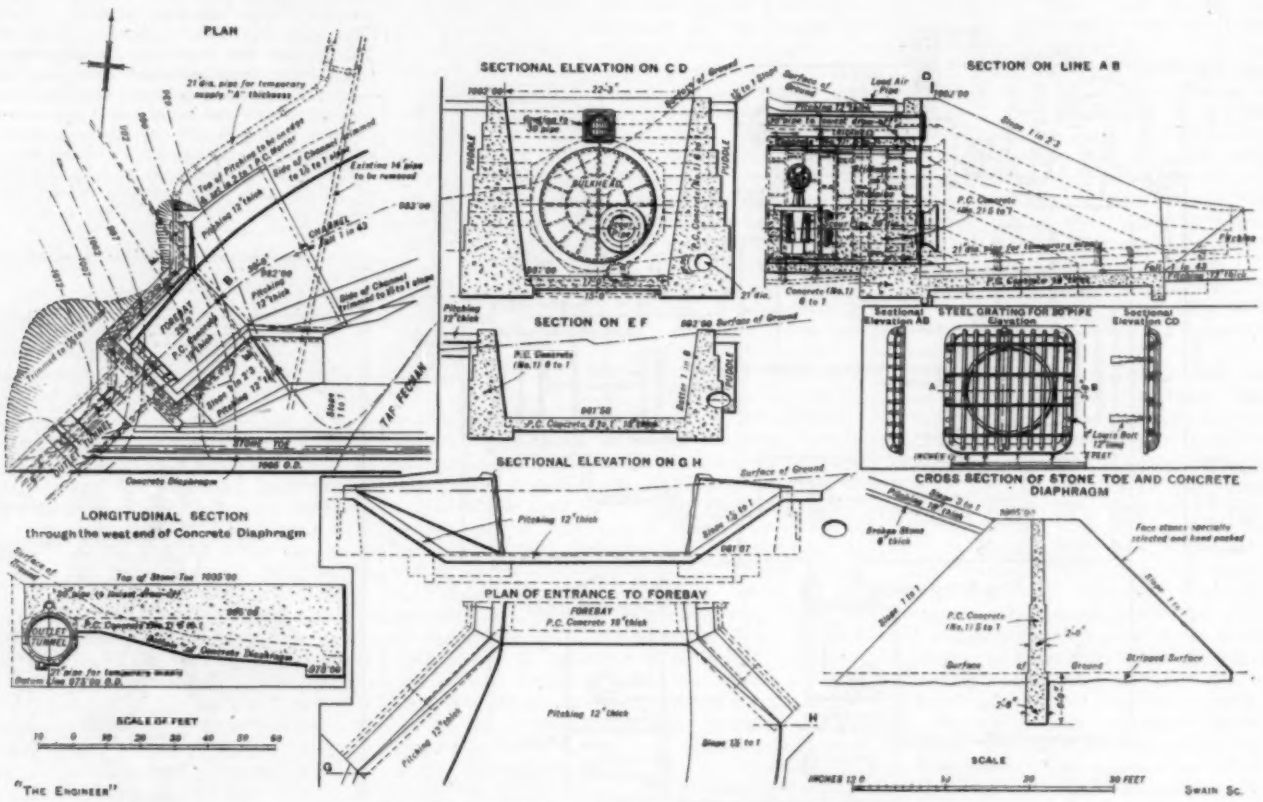


FIG. 2—DETAILS OF FOREBAY AT ENTRANCE TO OUTLET TUNNEL

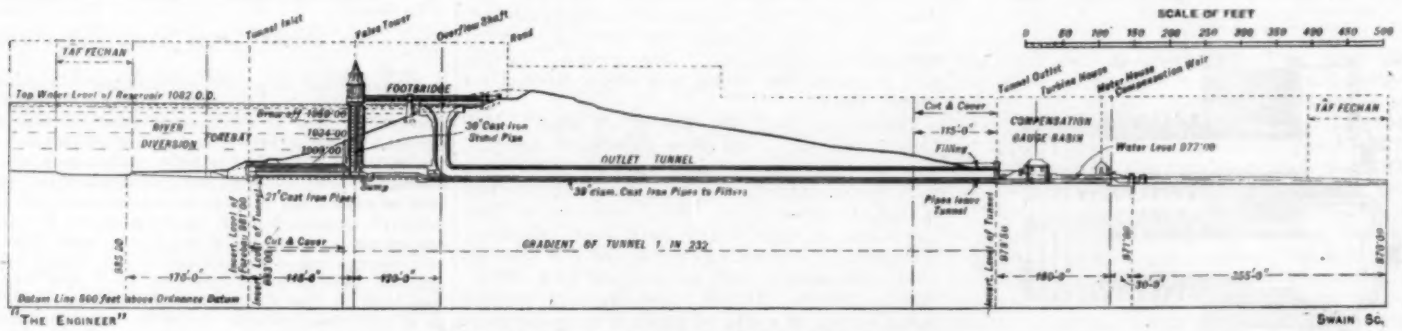


FIG. 3—SECTION ON CENTRE LINE OF OUTLET TUNNEL

of the Great Western Railway, which runs along the eastern slope of the valley, and it is, in fact, the third largest reservoir in Wales, being only exceeded by the Caban Coch reservoir, of the Birmingham Waterworks in the Elan Valley, and by Lake Vyrnwy, of the Liverpool Waterworks in North Wales.

To divert the flow of the river during the construction of the dam, a circular tunnel 13ft. in diameter was driven in the west bank of the stream, in such a position as to be well beyond the western end of the dam. The total length of the tunnel is 1046ft., which includes 120ft. of cut and cover at the inlet end and 115ft. at the outlet end. At the inlet end, the tunnel face and wings are constructed of concrete, and the cut-and-cover portion is made up of cast iron segments—much in the same way as are the linings of tube railways—surrounded by at least 12in. of cement

concrete, the inner flanges being filled and just covered with fine concrete brought to a smooth face, and the joints between the segments caulked with iron filings and salammoniac. The arrangement of the forebay at the inlet end are shown in Fig. 2. The direction of the forebay is at an angle of 45 deg., with the line of the embankment, and the middle portion of the tunnel is curved to a radius of 125ft., and then brought back by a length of straight and a reverse curve to discharge at right angles with the outlet masonry face which is parallel with the embankment. The discharge is into a compensation gauge basin. The tunnel was driven for the greater part of its length in solid rock, but at the southern end there was a considerable length that had to be driven through running sand drifts. It is lined throughout with 5 to 1 cement concrete with a 4½in. internal facing of brick, the whole totalling 2ft. in thickness, excepting for a length of 184ft., which had to be driven under low-pressure compressed air and was lined with cast iron segments as at the inlet end. Provision was made for grouting the tunnel with lime and cement grout under a pressure of 40 lb. per square inch, from various points through pipes left in for that purpose. There are now two stoppings in the tunnel, one, a cast iron bulkhead, at the inlet, and the other of mass concrete immediately upstream of the overflow shaft to which reference will be made later. A 39in. scour pipe is provided through the tunnel. It discharges downstream of the overflow shaft, and is controlled by a 28in. valve near the inlet stopping.

The river, during the progress of the constructional works, was discharged into a compensation gauge basin, and then over a weir with a temporary 90 deg. notch, and a flood crest 80ft. long into the old river bed. When the reservoir was being filled, the notch was blocked up, and the compensation water, amounting, as said above, to 6,835,000 gallons per day, is passed through four 9in. circular orifices in the 80ft. compensation gauge basin weir, means being provided, in a clear water tank valve well, for a float regulating apparatus to maintain the constant head above the orifices necessary to give the required discharge. A longitudinal section of the outlet tunnel showing the relative positions of the forebay and inlet for the river, the valve tower, the overflow shaft, the compensation gauge basin and weir, is given in Fig. 3.

The cut-off trench along the centre line of the embankment is 6ft. wide in the centre, tapering to 5ft. wide at the eastern and western ends. It was sunk through the glacial drift down to, and for a depth of from 15ft. to 20ft. into, the old red sandstone and marls. In the middle of the valley it had to be taken down to a depth of 86ft., but it presented no engineering difficulties, and the measures of the sandstone formation, when entered, were found to be quite undisturbed. Satisfactory ends were found in each case, that for the eastern side by means of driving a heading under the railway. The trench was filled to the level of the stripped surface of the ground with 5 to 1 cement concrete, being finished off with a nosing or "knife edge," the sides being curved to a radius of 10ft.—see Fig. 4. The aggregate for the concrete was composed of grey grit stone from quarries belonging to the Board, which lie some half a mile from the embankment site. This grey grit stone, which immediately underlies the old red standstone measures is of very close texture, and exceedingly hard, containing as it does nearly 98 per cent. of pure silica. All the sand required for the concrete throughout the work was formed of this material crushed and ground on the site.

The puddle wall embraces the top of the concrete of the cut-off trench in the manner shown in Fig. 4. The clay employed was boulder clay obtained from an extensive deposit at Dowlais Top, which lies some 3 miles from the dam site. It was brought on the Great Western Railway to Pontsticill Junction, which overlooks the works, and thence by a 4ft. 8½in. gauge temporary road to the trench. The only treatment that the clay received was that of ramming in 6in. layers, which were afterwards cut four times—transversely and longitudinally, transversely and longitudinally—with tools 13in. long, the cuts being approximately 4in. apart. Sufficient water was used in the first three cuts to render the clay plastic. Large stones were taken out in the clay field, but smaller stones, which did not interfere with the cutting, were welcomed rather than removed. The foundation for the puddle core was formed by excavating on each side of the concrete cut-off wall for such a width as to allow for a batter of 1 in 12 to be given to the puddle core on either side, and so as to give a top width—3ft. above top water level—of 6ft. The wall is thus some 23ft. wide at the original ground level. It was taken down vertically 7ft. from the ground level, and then sloped downward to the concrete wall on either side at an angle of 30 deg. to the horizontal.

The embankment has a width at the base of 545ft. The outer toes are composed entirely of stone averaging 15ft. high and finished 10ft. wide at the top. The outer faces of these toes are formed to a slope of 1 to 1. On the inner side of the embankment the top level of the toe is 1005ft. above O.D., and on the outer side 1000ft. O.D. From the stone toe on the north, or water, side, the earthen embankment is brought up by a slope of 3 to 1, while on the south side the slope is 2½ to 1. The top of the embankment is carried up to 7ft. above top water level. It is 20ft. in width, and has a macadamised road, 14ft. wide, across it. The embankment is composed of materials excavated by two steam navvies from the moraine deposits in the valley to the northward, and conveyed to the site by locomotives operating on 3ft. gauge temporary roads. These navvies were of the Ruston crane type—No. 12 and No. 10—with 2-cubic yard and 1½-cubic yard buckets respectively. All the finer and more retentive material was selected and placed against the puddle core and the coarser and stony material in the other portions of the embankment. No punning was done, as with the class of material available, an ideal consolidation could be obtained by the free use of an abundant supply of water.

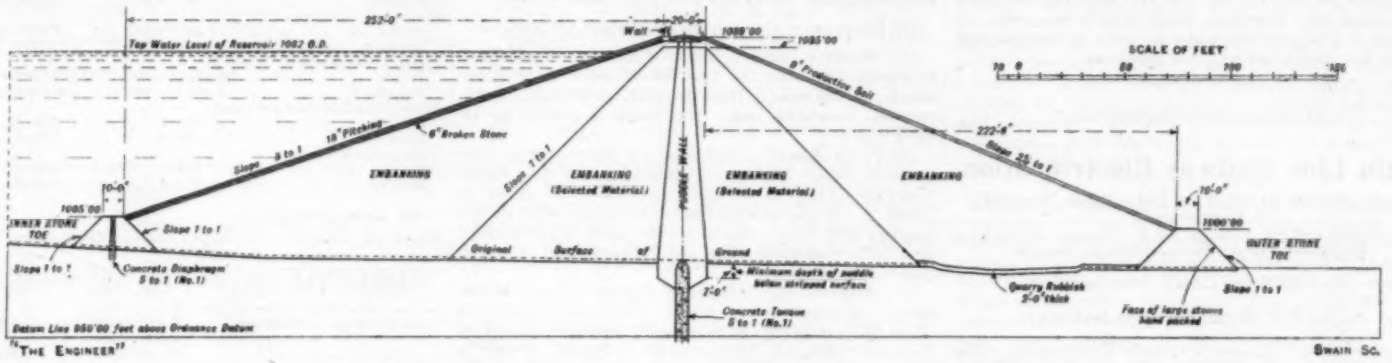


FIG. 4—TYPICAL CROSS SECTION OF THE TAF FECHAN RESERVOIR EMBANKMENT

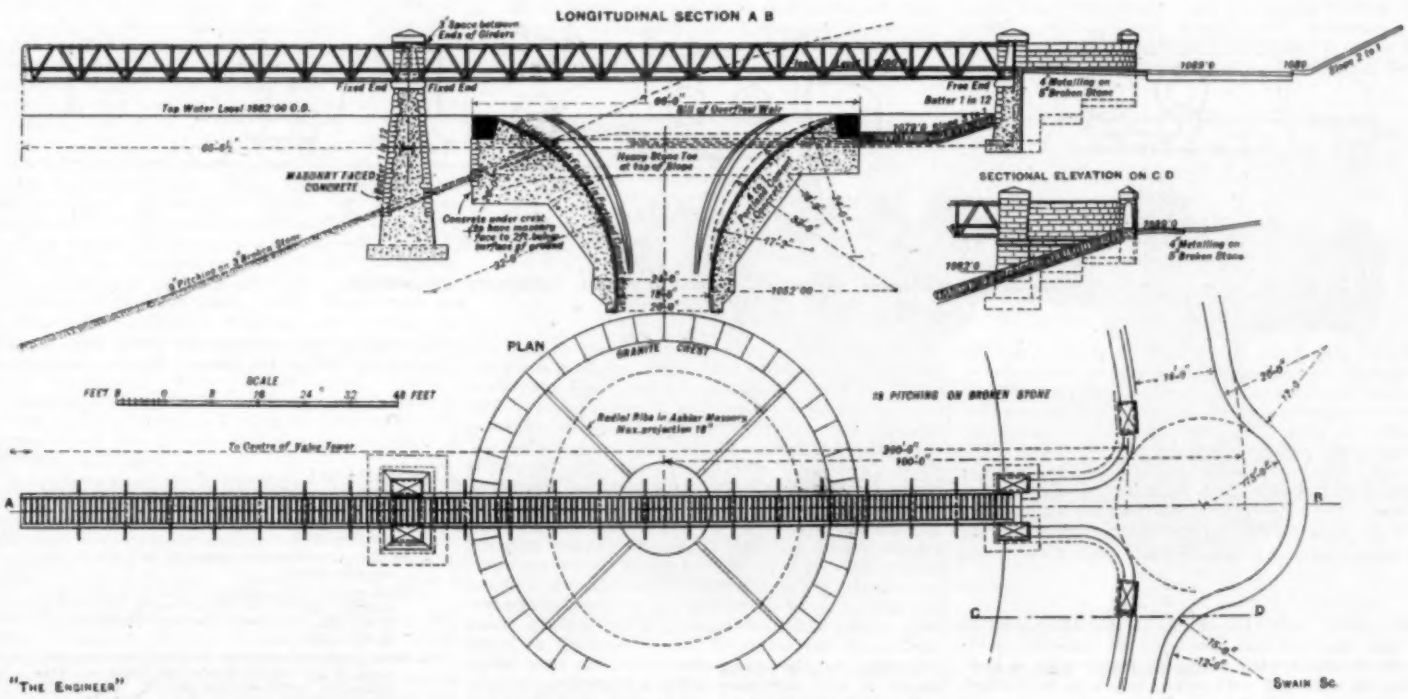


FIG. 5—SECTION AND PLAN OF OVERFLOW SHAFT

The quantities of materials used to form the embankment and the concrete core beneath it were :—

In the cut-off trench—		
5 to 1 cement concrete	18,614	cubic yards
In the embankment—		
Puddle core	34,611	,,
Selected material next core	240,000	,,
Outer material	407,000	,,
Stone toes	12,579	,,
Pitching and beaching inner slope ..	35,000	super yards

A distinctive feature of the undertaking is the overflow shaft, which is illustrated in Fig 5. The embankment has no spillway, but the whole overflow from the reservoir will be led away down an overflow shaft built above the outlet tunnel and downstream from the valve tower, with which we propose to deal in a subsequent article. The overflow shaft terminates at the top in a bell mouth which has a periphery of 207ft., and a diameter of 66ft. This bell mouth is

reduced to a shaft of 16ft. in diameter, which is taken down to the discharge tunnel. The shaft is lined with a 4½in. skin of brickwork, backed with 5 to 1 cement concrete to a total thickness of at least 24in. At a height of upwards of 70ft. from the invert of the tunnel this shaft begins to widen out, as shown on the drawing, until at top water level the diameter of 66ft. is attained. An overflow cill of "Shap" granite is arranged round the top edge. In the bell mouth portion, four curved radial ribs project outwards into the shaft with a maximum projection of 18in. in order to counteract any tendency towards vortex action.

Two views, showing the up and down stream sides of the dam, are given on page 124.

In our next article we propose to deal not only with the draw-off valve tower, but also with the extensive treatment and filtration plant which has been installed to deal with the water in order to remove peat stain, &c., as well as with the pipe line.

(To be continued.)

Main Line Railway Electrification.

By Sir PHILIP DAWSON, M. Inst. C.E., &c., Consulting Engineer, and
S. PARKER SMITH, D.Sc., M.I.E.E., Professor of Electrical Engineering, Royal Technical College, Glasgow.

No. XIX.—ITALY (*concluded*).*

4. (A) The Italian State Railways.

Locomotives.—(*a*) *Low-frequency Three-phase.*—The great simplicity of the three-phase induction motor, together with its mechanical robustness, results in a lighter and simpler construction than is possible with any other form of electric haulage. The low frequency enables gearless drives to be used. Light weight is of advantage in Italy, where the axle loading must not exceed 15 tons. Further, the normal tractive effort must not exceed 10 tons, that being the allowable limit on the draw gear. It has been found possible to construct electric locomotives to satisfy these conditions while developing 2000 kW at 75 kiloms. per hour, and having a total weight of 75 tons. It is the practice to run trains with two locomotives each, one at the head and one at the rear.

The principal locomotive types are the series E 550 and the series E 330. The former are designed for heavily graded routes, and have a "five-coupled" or E axle arrangement. Two motors are used, driving the middle driving axle by Scotch-yoke transmission. The central wheels have no flanges, as the locomotives have to negotiate sharp curves. Two economical speeds, 25 kiloms. and 50 kiloms. per hour, are obtained by parallel and cascade switching. The series E 330 is intended for railway routes in the lower districts and plains. The construction is somewhat similar to the series E 550, but the axle arrangement is 1 C 1. Four speeds are obtained, as below:—

37·5	kiloms. per hour,	motors with	8	-pole	connection in	cascade
50	,,	,,	6	,,	,,	,,
75	,,	,,	8	,,	,,	parallel
100	,,	,,	6	,,	,,	,,

These speeds have been chosen so that there may be at least one common speed for all locomotives, to enable double-headed trains or trains with a locomotive at each end, with mixed types, to be worked. Data concerning E 330 and E 550 and variations of them are given in Table V. and Fig. 9 *ante*.

(*b*) *Normal-Frequency, Three-phase.*—Present-day developments have enabled trials with three-phase energy at 10,000 volts and 45 cycles to be made on the Rome–Sulmona and Rome–Nettuno lines. For these schemes locomotives have been supplied with geared transmissions—as shown in Table V. and Fig. 11. The Brown-Boveri Company has supplied four passenger and four freight locomotives of 1 D 1 and E axle arrangement respectively. The drive is transmitted by pinions on both sides of the motors to twin gears on the jack shafts, and thence by a Scotch yoke to the central coupled axle. The motors are pitched high to raise the centre of gravity. Four speeds are obtained by pole-changing—6 and 8—and cascade/parallel connection. According to the number of poles the rotor winding is either three or four-phase, and is connected by seven slip rings to the liquid starter. An oil-immersed transformer lowers the contact line voltage to about 1000 volts for the motors. Regenerative braking, sufficient to hold the entire train, is automatic. The Soc. Ital. Ernesto Breda has developed a new locomotive type for the high-voltage, three-phase lines, of 1 D 1 axle arrangement. Three speeds are obtained by pole-changing. Data are given in Table V. *ante*.

(B) Privately Owned Electrified Railways.

(*a*) *Santhia–Biella.*—The "Ferrovia di Biella" Company operates the line Santhia–Biella in Piedmont, 30 kiloms. in length, with 4000-volt direct-current, overhead line. The route is graded up to 15·2°/₀₀.

(*b*) *Turin–Lanzo.*—This is also a direct-current line at 4000 volts. Power is supplied by the Alta Italia Company. Details of the locomotives are given in Table V.; it will be noted that the pressure per motor reaches 2000 volts. Speed control is by series-parallel and field weakening, the latter being used only for passenger traffic.

(*c*) *Bergamo–San Giovanni Bianco* (*Valle Brembana*).—A single-phase railway with heavy gradients up to 24°/₀₀ and curves of a minimum radius of 150 m. The line voltage is 6000 volts at 25 cycles. Power is obtained from the Camerate Comello station on the river Brembo, 1 kilom. from San Giovanni. The railway deals with both passenger and goods traffic. Owing to the facility with which electric power could be obtained from the river Brembo, electric traction was decided upon from the opening of the line.

(*e*) *Terni–Umbertide.*—This is an 11,000-volt, 25-cycle, single-phase line, run by the Mediterranean Company and supplied from the Papigno power station. It is 108 kiloms. in length, running through the Apennine Mountains. The maximum gradients reach 20°/₀₀.

The four lines noted above are the chief electrified normal-gauge privately owned railways.

5. Results of Electrification.

The most important of the State lines electrified at the present day in Italy had already reached the limit of their capacity with steam traction, and that, combined with ventilation troubles, made electrification urgent. Results have been very satisfactory. The annual traffic on the two Giovi lines before electrification was about 500 million virtual metric ton-kilometres, while a few years after the electrification the traffic reached 1200 million virtual ton-kilometres. Similarly, on the Mont Cenis line, the traffic increased from 110 million to a mean of 400 million virtual ton-kilometres. A threefold traffic increase has occurred on the Savona–Ceva line. One of the reasons permitting the use of the lines for so heavy a traffic is the uniformity of speed which is a special characteristic of the induction motor. This constant speed enables all the trains to follow regularly at equal intervals, and the trains conform to the time-tables except in very rare cases when a breakdown occurs.

Owing to the limits in the weight and draw-bar pull of the Italian locomotives, double traction (*i.e.*, a locomotive at each end of the train) has been found to give very satisfactory results, as any small differences in wheel diameter can be compensated for by the insertion of rotor resistance in the motors of the locomotive with the larger wheels. The load can in this way be shared equally between the two locomotives.

Recuperation of energy is obtained in the three-phase locomotives without any special switching whatever, regeneration being automatic. It has been shown that on some lines the recuperated energy may exceed 50 per cent. of the total consumption of trains climbing the gradients.

On June 30th, 1926, there were in actual operation on the Italian State Railways 914 kiloms of route, comprising 1930 kiloms. of single track. Feeding this electrified system were thirty-two transformer sub-stations with a total installed capacity of 130,200 kVA, ten converter sub-stations with a total capacity of 22,900 kVA, and eleven mobile transformer sub-stations totalling 22,930 kVA. In addition to the above, the State was operating 75 kiloms. of route (82·5 track kiloms.) of standard and narrow-gauge line in the Trentino, with four sub-stations totalling 1530 kVA installed capacity.

(*a*) *Train and Locomotive Kilometres.*—The following table shows details of the traffic on the Italian State Railways (both steam and electric) during the years 1924–5 and 1925–6:—

Table VIII.—*Traffic Figures.*

	1925–6.	1924–5.
Train-kiloms.:		
Steam	123,855,319	116,659,154
Electric	13,044,857	10,598,989
Locomotive-kiloms.:		
Steam	143,265,419	134,986,121
Electric	16,428,615	13,780,647
Shunting loco.-kiloms.:		
Steam	24,304,842	23,875,182
Electric	256,284	283,734
Trailing ton-kiloms.:		
Steam	36,482,000,000	35,065,000,000
Electric	4,609,000,000	3,800,000,000
Average trailing load per train:		
Steam	254·6	259·8
Electric	281·9	277·0
Average train weight:		
Steam	294·7	300·8
Electric	341·4	346·0

(*b*) *Energy Supply.*—

Table IX.—*Output of Generating Stations for Railway Load, 1925–6.*

Owner.	Station.	Remarks.	kWh.
State Railways	Morbegno	For Valtellina line	11,139,980
		Monza–Lecco	4,882,290
		Supplied to Edison Co.	8,879,546
	Bardonecchia	Generated	37,876,793
		Transformed from outside supply	3,429,957
	La Chiappella	Generated by steam	3,402,000
Maira and Negri	—	Hydraulic st'ns.	106,567,356
		Steam stations	8,503,290
Edison Co.	Robbiate	—	4,882,290
	Pallanzeno	—	5,222,000
Dynamo Co.	Varzo	—	12,509,379
Turin Municipal	—	To Bardonecchia	3,429,957
		To Maira Co.	1,618,944
Torbrera Co.	Torre del Lago	—	25,305,097
Meridional Elec.	—	—	3,104,119
			171,202,357

Total energy consumption on Italian State Railways.

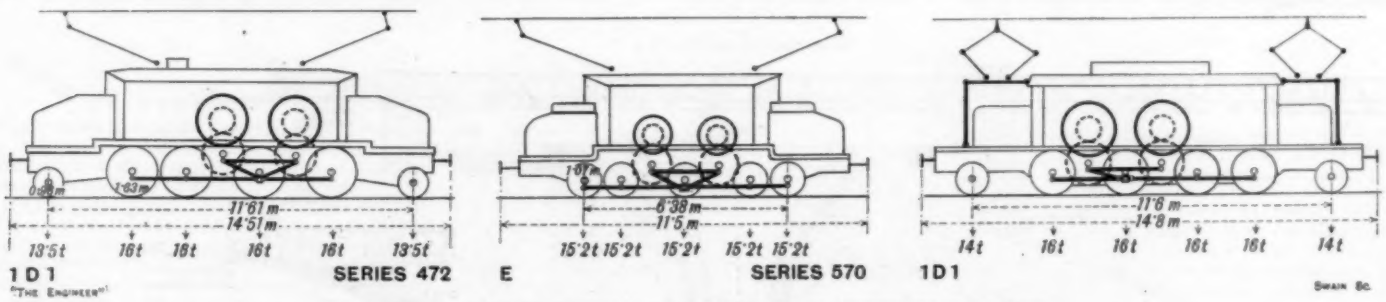


FIG. 11—ITALIAN STATE RAILWAYS: 3-PHASE, NORMAL FREQUENCY LOCOMOTIVES

Table X.—*Specific Energy Consumption on the I.S.R.*

	Wh. per virtual ton-km.
Three-phase lines:	
1. Mean power consumption at contact wires on the Pontedecimo–Busalla section. Gradients up to 35°/₀₀. Train speed 45 km. per hour. Trains climbing only	19
2. As above, with trains climbing and descending simultaneously	8 to 9
3. Mean power consumption, for one year, including auxiliary services, at the generating station (La Chiappella); 13 km. from the Pontedecimo–Busalla line	24
4. Mean power consumption including auxiliary services, at the switchboards of the Maira and San Dalmazzo hydro-electric stations during the three winter months of 1918; about 150 km. from the electrified lines	30
Direct-current line (Milan–Varese):	
5. Power measured at the power station switchboard, 20 km. from the Milan–Varese line	46

Table XI.—*Annual Costs, 1925–26.*

Item.	Steam.	Electric.
Management and operation of locomotive sheds, coal supplies, drivers, stokers	343,597,333	—
Management and operation of locomotive sheds, power supply, locomotive and power station *personnel*	—	26,663,215
Maintenance, mechanical parts	307,383,191	17,726,777
Maintenance, electrical parts	—	6,255,145
Maintenance, electric plant and lines	—	7,133,342
Totals	650,980,524	57,780,479
Cost per trailing ton-km., lire	0·018	0·0124

be somewhat greater. The saving in coal on the electrified lines amounted to 360,000 tons, equivalent

* Nos. I., II. and III. (Switzerland) appeared June 6th, 13th and 20th, 1924; Nos. IV. and IVa. (Scandinavia) appeared January 23rd and February 6th, 1925; Nos. V. and VI. (Germany) appeared June 5th and 12th, 1925; Nos. VII. and VIII. (Austria) appeared August 21st and 28th, 1925; Nos. IX. and X. (France) appeared October 2nd and 23rd, 1925; Nos. XI. and XII. (U.S.A., North-Western States) appeared February 12th and 26th, 1926; No. XIII. (U.S.A., South-Eastern States) appeared March 26th, 1926; Nos. XIV., XV. and XVI. (U.S.A., North-Eastern States) appeared November 26th and December 3rd and 10th, 1926; Nos. XVII. and XVIII. (Italy) appeared July 8th and July 22nd, 1927, respectively.

to 68 million lire, at the average price of 189·17 lire per ton, as compared with 177·66 lire for 1924–5.

(*c*) *and* (*d*) *Specific Energy Consumption and Annual Costs.*—Rough figures observed are given in Tables X. and XI.

TABLE XII.—*Italian Main Line Electrification—Capital Cost of Certain Installations.*

Line.	Traction installations, primary mains, transformer sub-stations.	Additional expenses, communication circuits, &c.	Loco. sheds, repair shops, &c.	Generating plant and standby.	Total.
	Lire.	Lire.	Lire.	Lire.	Lire.
Milan–Varese	5,720,000	500,000	780,000	—	7,000,000
Valtellina	6,099,000	286,000	540,000	3,500,000	10,425,000
Lecco–Monza	3,400,000	585,000	230,000	—	4,215,000
Giovi (Genoa–Ronco ; Genoa–Mignanego)	12,110,000	1,450,000	1,055,000	4,018,000	18,633,000
Savona–Ceva	2,515,000	867,000	895,000	—	4,277,000
Savona–Sampierdarena	3,150,000	850,000	—	—	4,000,000
Turin–Pinerolo	1,740,000	340,000	210,000	—	2,290,000
Bussoleno–Modane	8,250,000	1,255,000	916,000	—	10,421,000
	42,984,000	6, 33,000	4,626,000	7,518,000	61,261,000

(*e*) *Capital Costs.*—The costs of the chief installations are of interest, and are quoted in Table XII.

Institution of Naval Architects.

No. III.*

SUMMER MEETING.

Visits at Cambridge.

FROM the time when the visit to Cambridge was first proposed, the University authorities welcomed the plan, and many colleges contributed to its successful carrying out. Apart from the more public entertainments, all the colleges made offers of accommodation for those attending the meetings, and three groups of members were allotted undergraduates' rooms in the colleges of King's, Queen's, and St. John's, which were chosen as being most convenient. Those members who were fortunate enough to partake of such hospitality will not readily forget the friendly welcome they received. In the three days spent at Cambridge some opportunity was also provided of enjoying the beauties of architecture for which the town, the University and its colleges are justly famed.

After the meeting on Tuesday morning there was a luncheon in the Hall of Pembroke College, and the afternoon was spent in visiting various colleges, including St. John's, Trinity and King's, as well as the Pepys Library at Magdalene College. Tea was served at the Engineering Laboratory, and in the evening a delightful reception was given by the Vice-Chancellor of the University and Mrs. Weekes in the Master's Lodge and beautiful gardens of Sidney Sussex College.

The reception given by Professor and Mrs. Inglis in the Engineering Laboratory on Wednesday evening was full of pleasing surprises. Interesting exhibits were arranged in Scroope House, the electrical laboratories, the structures and hydraulics laboratory, the heat engine laboratory and in the metallurgical and aerodynamics departments. A full description of the laboratory was, we may say, given in THE ENGINEER of October 24th, 1924. There was an excellent cinema display showing the changes in crystal structure which accompany the breaking of an iron specimen, and illustrating the research carried out in the laboratory. The "Pathé" film "Speed," culminating in Major Seagrave's recent motoring record, was also shown. During the evening part of the band of the Royal Engineers contributed a musical programme.

In the laboratory there was also a comprehensive display of instruments exhibited by the Cambridge Instrument Company, Ltd. The works of that company were thrown open during working hours, and members of the Institution were also invited to inspect the Cold Storage Research Station, where work is going on on low temperature research.

On Thursday, the papers were read in the very fine lecture theatre of the Arts School, after which there was a luncheon in the Hall of Caius College. All members were present at the "capping" ceremony, which took place at 3 p.m. on Thursday afternoon, when the degrees of Doctors of Law (*honoris causâ*) were conferred upon His Grace the Duke of Northumberland, President, Sir Archibald Denny and Sir Eustace Tennyson d'Eyncourt, Vice-presidents, of the Institution. The same afternoon a reception was held in the Hall of King's College, which took the place of a garden party that could not be held in the gardens of the college, owing to inclement weather. After the reception, many members of the party attended the choral service in King's College Chapel.

The banquet of the Institution was held in the Hall of Trinity College on Thursday evening, July 14th, at which 145 members and guests of the Institution were present. The toast of "The University of Cambridge" was proposed by the Duke of Northumberland, President of the Institution, and was supported by Mr. Francis Henderson. It was replied to by the Rev. G. A. Weekes, the Vice-Chancellor of the University. The Master of Trinity College, Sir Joseph J. Thomson, proposed the toast of "The Institution of Naval Architects," and Sir Charles Parsons replied. Madrigals, rendered by members of the choir of Trinity College, under Dr. Alan Gray, added charm to a memorably pleasant evening.

If we may single out any names among those who made the arrangements in Cambridge so very complete and contributed to the success of the meeting, we should mention Professor C. E. Inglis, and his able assistant, Mr. A. H. Chapman.

The Bedford Visit.

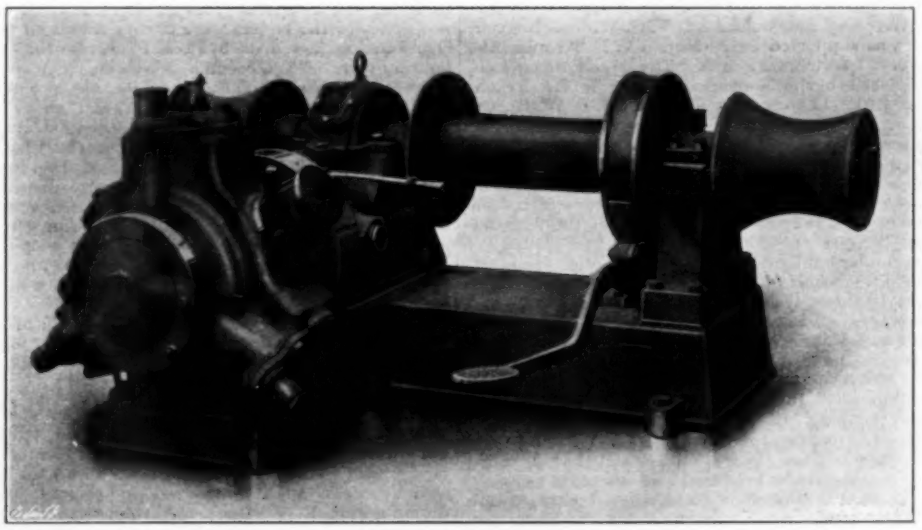
On Wednesday morning, the 13th inst., the whole party travelled to Bedford by motor, to inspect there the works of W. H. Allen, Sons and Co., Ltd. They were received by the chairman and directors of the company at the Biddenham Works shortly after 11.30 a.m., and most of the morning was spent inspecting the well-planned and excellently equipped pattern shops and foundries. Much interest was displayed in the testing of materials laboratory. Before luncheon an opportunity was taken to visit the firm's playing fields, and Institute in the Hurst-grove, adjoining Queen's Engineering Works, where luncheon was served. In welcoming the party to Bedford, Mr. Richard Allen referred to the importance of the occasion, which was one of note in the annals of the firm. He outlined briefly the progress and development in marine auxiliary machinery, which had been made within recent years, and stated that his firm was ready to meet every new phase of development. In his reply, the Duke of Northumberland made reference to the happy relations which it was evident existed between employer and employee at the Allen works, and said that the social and welfare arrangements were, he thought, unsurpassed in the country.

After luncheon the ladies of the party visited places of historical interest in the town of Bedford and the village of Elstow, and rejoined the main party at tea. In the Queen's Works examples of reciprocating engines, steam turbines, and oil engines were seen under construction and on test, and interest was shown in the many-sided character of the electrical work connected with the manufacture of motors, generators and switchgear for marine service. Notable examples of large work were found in the four 16,000 square feet condensers going through the shops for the city of Edinburgh, and the auxiliary machinery which is being built for the Royal Spanish Navy. An interesting unit on test was a 1000 B.H.P. pass-out turbine for the Brunner Mond Company, while pumps and turbines for industrial use, both in this country and in our Colonies and Dependencies, as well as overseas countries, were in evidence. Interest was displayed in the special pumps manufactured by the firm for marine service, which are described in a separate article on page 132 of this issue. In the oil engine department the visitors were shown examples of the Allen type of hot-bulb engine, which is still largely in demand, as well as numerous Allen-B. and W. units for ship lighting service, which are to be supplied to British built motor vessels. Patterns and castings were seen for a new pattern of auxiliary oil engine of the air-injection type, which will embody many important improvements. Such engines are on order for ships of the Canadian-Pacific Line, and orders have recently been booked for eight sets of 450-kW capacity, consisting of a combined Allen-B. and W. four-cycle six-cylinder unit, direct coupled to a 225-volt compound-wound generator. They are to be built to the order of the Nippon Yusen Kaisha for motor vessels under construction at the yard of the Mitsubishi Zosen Kaisha at Nagasaki. The sets will each have a weight of approximately 55 tons, with an overall length of 26ft. Arrangements are being made to supply the new design of engine to work either with air injection or the airless injection system as desired. A two-cylinder high-speed engine working on the airless injection principle, which has been designed and built for experimental purposes, indicated a probable line of future development.

Visits at Ipswich.

On Friday morning, July 15th, the party, under the leadership of Sir John Biles, Vice-president, left Cambridge for Ipswich, arriving shortly before eleven o'clock. The ladies were met by the Ipswich Ladies' Reception Committee, and were shown places of historical interest in the town. The main party proceeded to the works of Reavell and Co., Ltd., where they were received by Mr. William Reavell, Mr. Kingsley Reavell, and members of the firm's staff. Various departments in the works were inspected, and all kinds of air compressing machinery, both for marine and industrial use, were seen in course of construction. We may briefly mention a few of the more interesting items.

One of these was the ship's winch designed for working with low-pressure compressed air, which is illustrated below. It is constructed to lift weights up to 2 tons at a speed of 60ft. per minute. The air engine driving the winch is a three-cylinder unit. It works the winch barrel through a worm gear, and a reversing gear is also provided. The foot brake will be noticed to the right of the view we reproduce, and the convenient position of the hand-operated control valve may also be seen. The air pressure employed is only 40 lb. per square inch for full duty, and by installing a 100 lb. pressure receiver only quite a small compressor is needed, as air can be stored during the idle periods between lifting the loads. The air is used non-expansively, and no undue cooling takes place. Mr. William Reavell has advocated this system of working for many years, and it would seem to be suitable for many purposes on small or moderate-



SHIPS' WINCH WORKED BY COMPRESSED AIR—REAVELL

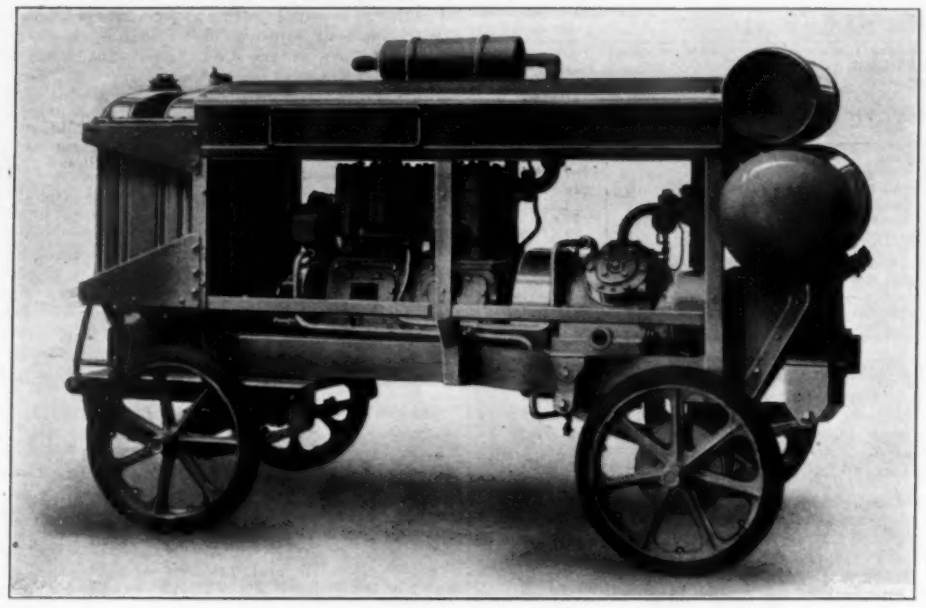
sized ships, such as coasting vessels, on which, owing to their size, electrical or steam machinery would prove costly to install and to operate. We were interested to learn that a complete installation, comprising an air-operated steering gear, anchor windlass, and deck winches, is being constructed by the firm for an Argentine tug.

In the courtyard of the works we noted a number of portable air compressors ready for delivery to various municipalities at home and abroad. Our illustration on page 118, shows one of the larger No. 4 type of machines, which is constructed to work from four to six compressed air tools. A noticable feature is the direct-coupled air compressor, which is now constructed with roller bearings throughout. A robust marine type of petrol engine built by the Atlantic Engine Company, Ltd., of Wishaw, Scotland, is employed to drive the compressor, which is complete with its storage vessel and automatic unloading device. In

* No. II. appeared July 22nd.

PORTABLE AIR COMPRESSING SET

REAVELL AND CO., LTD., IPSWICH, ENGINEERS



the shops a variety of compressed air tools, such as picks, clay diggers and concrete breakers, were shown in progress of manufacture. Among the marine compressors there was a number of three-stage steam-driven compressors designed for pressures of from 1000 lb. to 1200 lb. per square inch, that are to be installed on motor ships, which are now under construction on the Clyde. Other interesting units were the gas boosters and turbo-scavenge blowers. The method of building up the impellers was seen, and it was noted that means are provided for regulating the diffuser blade positions, so as to give a large control range for both pressure and volume. In contradistinction to the large compressors and blowers we have mentioned, we may single out the little surgical pump which is of the crescent chamber rotary type, and is now widely used in operating theatres to obviate the necessity of "swabbing." It may be held in the palm of one's hand, and is driven by a small electric motor. Such pumps are also supplied for laboratory work.

The luncheon was held in Messrs. Reavell's canteen, and the party was welcomed by Mr. William Reavell, who was supported by Alderman C. E. Tempest, the Mayor of Ipswich, Sir Ernest Petter, Mr. H. S. Aspinall, and officials of the Manganese Bronze and Brass Company, Ltd. Other guests included Col. F. W. Turner, and Sir William Burton. Mr. Reavell mentioned that hospitality was offered by no less than seven engineering firms in the town, but it was thought advisable to confine visits to the firms more closely associated with the manufacture of marine auxiliary and propelling machinery. In the unavoidable absence of the President, the Duke of Northumberland, Sir John Biles, Vice-president, replied on behalf of the Institution of Naval Architects, to the speeches of Mr. Reavell and Sir Ernest Petter. After luncheon, the ladies visited Christchurch Park and Mansion, and were afterwards entertained to tea in the grounds of "Broadwater" by Mr. and Mrs. Reavell. The main party proceeded by saloon omnibus to the works of the Manganese Bronze and Brass Company, Ltd. At these works the casting of billets for making rolled sheets, bars and extruded sections was seen. It was understood that extruded sections can now be produced with a limit of accuracy of $^{5}/_{1000}$in. Cast billets of 6in. diameter, with a length of 3ft. were seen extruded to form 1¼in. diameter bars and 1½in. by 1½in. angle section, while plates were rolled from 18in. square billets 1½in. in thickness to the desired thickness. In the forge, pump rods of anti-corrosive and anti-erosive metal were being forged 4in. in diameter, with a length of 6ft. There were exhibited some finely finished models of propellers, including those supplied to the H.M.S. Hood and the Cunard liner Mauretania.

Members of the party were received at the works of Petters (Ipswich), Ltd., shortly before three o'clock by Sir Ernest Petter, chairman, and Mr. H. S. Aspinall, the general manager of the company. Under the guidance of members of the staff, the party was conducted in groups through the chemical laboratory, the pattern shop and foundry, the machine shop, fitting, erecting and testing bays. In the foundry interest was displayed in the large jar-ramming moulding machines, which are used for the crank case, bed-plates, fly-wheels and other main parts of the engine. The machining of the various parts, their assembly and the final erection were followed, and in the erecting shop several examples of engines for industrial and marine use were seen. A notable group of machinery was that for the motor vessel Maui Pomare, which is being constructed for the New Zealand Government the Pacific Islands Administration Board. This vessel has the following particulars:—Length, 210ft.; breadth moulded, 35ft.; depth moulded, 16ft.; with a draught of about 14ft. and a designed speed of 11½ knots. She is a little larger than the tug Southlands, the machinery for which was described and illustrated in THE ENGINEER of October 15th, 1926. The main propelling machinery comprises two six-cylinder units, each designed for an output of 600 B.H.P., at a normal speed of 270 r.p.m. There are also two 55-kW oil engine driven generator sets. The auxiliary units and the main engine were seen in the erecting shop, and the other main engine was being tested at the time of the visit. It will be recalled that the six cylinders of this engine each have a bore of 16½in., with a stroke of 18in., and that a low-compression pressure of 320 lb. is employed. The engine is equipped with an automatic reversing gear, all manœuvres being effected by the rotation of a single reversing hand wheel. The excellent manœuvring properties of the engine were demonstrated on test. Other engines included a 375 B.H.P. unit for the town lighting plant at Toowoomba, Australia. The recent orders for marine auxiliary sets include two four-cylinder generator units, each with an output of 250 B.H.P., or 165 kW, for the new P. and O. turbo-electric liner, which is being built at the yard of Alexander Stephen and Son, Ltd., at Linthouse, Glasgow. Considerable interest was also displayed in the new experimental piston valve, automatic, scavenge engine, which was shown in operation driving an electric generator. It has a designed output of 750 B.H.P. at 300 r.p.m. There were some fourteen engines in the testing bay, of which nine were shown running.

After tea, which was served in the firm's offices, the main party left for the station, and there joined the ladies' party, London being reached the same evening.

The Cambridge meeting of the Institution of Naval Architects will rank high among the many memorable meetings of recent years, which have been held both at home and abroad. It was a happy thought which prompted Mr. R. W. Dana, the secretary, to suggest the Cambridge visit, and to him and his assistant, Mr. A. Dansie, the thanks of the party are due for the very excellent and smooth way in which all arrangements were carried out. It was good for those engaged in the actual industries of shipbuilding and marine engineering to meet in friendly intercourse with those who are leading educational progress, both in its wider and more general, and in its perhaps more limited technical sense. There is no doubt, too, that the visits to the manufacturing centres of Bedford and Ipswich emphasised in the minds of many the greatly increased importance in recent years of ships' auxiliary machinery.

A BUCHAREST correspondent of the *Manchester Guardian* recently stated that negotiations were in hand between the Roumanian Government and a New York banking group for a loan to rehabilitate the Roumanian State Railways. The bankers' representatives now in Bucharest are accompanied by Mr. Howard Kelley, an American railway expert, who is a former President of the Canadian Grand Trunk.

B.E.S.A. Specifications.

TRANSFORMERS FOR POWER AND LIGHTING.

A NEW British standard specification, which supersedes B.S.S. No. 72, 1917, applies to transformers for power and lighting having windings insulated with Class A and Class B materials, including auto-transformers and single and polyphase transformers, but does not apply to instrument and traction transformers. The actual specification is divided into twelve sections, and there are ten appendices, which include a great deal of useful information.

Definitions of all terms used in the specification are set out in Section 2, and further sections deal with types of cooling, standard voltages, frequency, classes of rating, &c. Limits of temperature rise for various types of transformers with both classes of insulation are given, and details of high-voltage, performance and type tests are set out in later sections. The last two sections deal with tolerances on stated performances and information to be given on the rating plate.

The appendices include a classification of insulating materials used in the construction of machinery and transformers, and give useful information on service conditions. Methods of measuring temperature rise and methods of declaring efficiency are dealt with very fully and formulæ are given for the calculation of inherent voltage regulation at various power factors.

Terminal markings have been brought up to date and in the same appendix standard diagrams of connections and vector diagrams have been set out. The final appendix gives detailed information and tables of figures for the measurement of voltage by the spark gap method.

Copies of this specification—No. 171, 1927—may be obtained from the B.E.S.A. publications department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

FLAME-PROOF TYPE PLUG AND SOCKET.

The British Engineering Standards Association has just issued a specification for a flame-proof type plug and socket, heavy duty, 100-ampère, for voltages not exceeding 660. The plugs and sockets described in this specification are primarily intended for use in connection with coal-cutting machines and the like portable apparatus in mines. The specification only deals with the dimensions necessary to secure interchangeability between plugs and sockets and with certain electrical and mechanical requirements. It does not specify a fully detailed design.

After defining the chief terms used, it gives instructions for connecting the plug and socket to the supply system. An appendix gives the gauges designed to test work made in accordance with the dimensions specified, and it is recommended that manufacturers submit their gauges and a model plug and socket to the National Physical Laboratory for checking. In order to make the specification complete, the British standard definition of flame-proof enclosure, including explosion-proof, for electrical apparatus from the British standard specification No. 229, 1926, is included. Recommendations are also given for securing interchangeability of plugs and sockets when an electrical interlock is fitted.

Copies of this new B.S. specification—No. 279, 1927—may be obtained from the B.E.S.A. publications department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

COLLIERY TUB DRAWBARS, SHACKLES AND COUPLINGS.

THE British Engineering Standards Association has just issued a British Standard Specification for the material for colliery tub drawbars, shackles and couplings. This specification has been prepared at the request of the Mining Association of Great Britain by Committees representative of both the buying and manufacturing interests, which have been assisted in their work by Regional Committees which have been formed in the large coalfields to insure that local conditions received the fullest consideration. It will, as in the case of all British Standard Specifications, be reviewed as experience of its working or progress in the industry renders it necessary, and revised issues will be published from time to time.

The specification provides two grades of wrought iron, one grade of mild steel and one of dead soft steel, to meet the various conditions and requirements of mines in the country. During the preparation of the specification it was felt desirable to use existing specifications as far as possible, in order that iron and steel makers should not be hampered by the creation of new grades and qualities. The recommended grades of wrought iron have, therefore, been taken from the existing B.S. specification No. 51, wrought iron for use in railway rolling stock, and the mild steel recommended is similar to the Grade A steel given in B.S. specification No. 15 structural steel for bridges and general building construction. No suitable B.S. specification existed for dead soft steel, and it was necessary to prepare a special specification for this purpose.

The present specification has been prepared in order to give the management of collieries an easy means of securing, by the stipulations of one of these specifications, that the drawbars, shackles and couplings of colliery tubs shall be made of suitable material. The stipulation of standards of quality in this way by the collieries, will enable them to secure fair competitive prices from the makers, and will, by the standardisation of material used, bring many economic benefits in its wake. The advantages of the use of good quality material is such important parts of colliery tubs as the drawbar and coupling, are very well known to mining engineers, and it has often been pointed out at meetings of the Colliery Committees when this matter has been under discussion, that the failure of a single drawbar or coupling, often results in a breakdown on the haulage plane underground which causes a cessation, in many cases of the regular output of a particular district, for many hours, and in some cases stops work for the day, involving a cost to the colliery, through the consequent falling out, many times greater than the difference between that of the better and inferior classes of material. Also while such breakages are very much diminished by the use of suitable specifications, it should not be forgotten that in the rare event of a breakdown causing injuries or involving loss of human life, the position of the colliery management is immeasurably strength-

cued if suitable precautions, such as the use of a B.S. specification, have been taken in the purchase of such parts as the drawbars, links or hooks.

Copies of this specification, No. 291, 1927, can be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

Great Western Railway Run to Plymouth.

WE published in our issue of July 1st an illustrated description of the new Great Western Railway locomotive, No. 6000, King George V. This engine has been designed with a view to hauling heavier loads to Plymouth, but to keep to the same schedule as that now in force. On the initial run to Plymouth, which took place on Wednesday, July 20th, whilst no effort was made to attain exceptional speed, the train arrived at Plymouth at 2.32 p.m. instead of 2.37 p.m., five minutes early. The formation of the train was as follows :—

Engine No. 6000 (King George V.), North-road.	Paddington to Plymouth,
70ft. van third	Paddington to Penzance
70ft. third	Paddington to Penzance
70ft. composite	Paddington to Penzance
Articulated set—	
1st diner, kitchen car, 3rd diner	Paddington to Penzance
70ft. van third	Paddington to Penzance
70ft. brake composite	Paddington to St. Ives
70ft. brake composite	Paddington to Falmouth
70ft. brake composite	Paddington to Plymouth
70ft. slip	Paddington to Weymouth, slipped at Westbury
70ft. brake composite	Paddington to Weymouth, slipped at Westbury

The weight of the train was 410 tons to Westbury and 338 tons to Plymouth. The weight of 338 tons to Plymouth was actually 50 tons in excess of the normal single-engine load over the Dainton and Rattery Banks, which have a rising gradient of 1 in 41 and 47 respectively, and 1 in 41 and 38 in the reverse direction.

We may say that on this occasion articulated stock was worked through to Penzance for the first time, and considering the acute curves which are met with beyond Plymouth, the stock behaved remarkably well. Sitting at the end of a coach of the articulated stock, the running was very comfortable, especially at the higher speeds.

Paddington to Plymouth, North-road. Locomotive No. 6000, King George V. Load to Westbury 410 Tons. Load from Westbury to Plymouth 338 Tons.

M. ch.	Places.	Booked times.	Actual times.	
	Paddington	10.30	10.30	
9 03	Southall	41	46	Engineering work. Stop ¼ minute Acton
9 30	Slough	50	54.30	
5 63	Maidenhead	55.30	11.00.15	
6 62	Twyford	11.01.30	07	
4 77	Reading	07	11.30	
17 09	Newbury	26	29	
13 26	Bedwyn	39.30	42	
	Savernake	—	46	70 miles in 75¼ minutes, 55·62 m.p.h.
29 12	Westbury	12.07.30	12.08.30	Slip. Slough to Westbury, 77 m. 9 ch., 74 min., 62·52 m.p.h.
19 63	Castle Cary	30	30	115¼ miles in two hours
	Somerton	—	40	
22 42	Cogload Junction	53	—	
5 03	Taunton	58	56	
	Wellington	—	1.03.30	Wellington to Whiteball Box, 3 m. 62 ch., 5 min., 45·3 m.p.h.
	Milepost 172	—	—	
	Milepost 173	—	—	
	Whiteball Box	—	1.08.30	
30 69	Exeter	1.29	26.30	Heavy rainstorm
20 18	Newton Abbot	53	1.50 1.50.15 1.51	Newton Abbot to Dainton Box, 3 m. 70 ch., 5¼ min., 42·27 m.p.h.
3 70	Dainton Box	59.30	1.56.30	
4 65	Totnes	2.05.30	2.03	
	Milepost 225	—	2.06	
	Tigley Box	—	2.06.45	
	Rattery Box	—	2.10	
6 69	Brent	15	2.13	Totnes to Brent, 6 m. 69 ch., 10 min., 41·17 m.p.h.
9 46	Hemerdon Box	27	—	
5 15	Lipson Junction Box	35	2.29	
1 41	Plymouth, North-road	2.37	2.32	5 minutes early
225 57				

Plymouth, North-road, to Paddington. Locomotive No. 6000, King George V. Load 338 Tons.

M. ch.	Places.	Booked times.	Actual times.	M.p.h.
	Plymouth	12.30	12.30	
1 41	Lipson Junction	33	34	22·58
5 15	Hemerdon Box*	42	41.15	42·9
9 46	Brent	54	53	48·89
6 69	Totnes	1.03	1.00.30	54·9
4 65	Dainton Box†	10	07	44·4
3 70	Newton Abbot	1.15	1.13	58·7
20 18	Exeter	39	40	44·94
30 60	Taunton	2.19	2.12	57·65
47 59	Westbury	3.09	3.01	58·44
20 12	Bedwyn	38	3.34.15	52·56
13 26	Newbury	50	47	62·7
17 9	Reading	4.08	4.02	68·44
35 47	Paddington‡	4.45	4.37	61·00
225 57		255	247	54·82

* Gradient 1 in 41. † Gradient 1 in 38. ‡ Arrival eight minutes early.

The work accomplished by the locomotive on the return journey was even better than that of the preceding day. With 338 tons behind the tender, a smart start was made at 12.30 p.m. from Plymouth. A fine performance was the climb of Hemerdon Bank, which took only 7¼ minutes to Hemerdon signal-box from Lipson Junction, the average speed for the 5 miles 15 chains being 42.9 m.p.h., which is a record. The climb to Dainton from Totnes was also good. The 4 miles 65 chains were run in 6½ minutes, half a minute under the 7 minutes allowed. From the tables it will be seen that no attempt was made at any excessive speed, and due attention was paid to all speed restrictions during the runs.

Moving a Large Bridge.

THE following account of the process of moving the spans of a large bridge in America is taken from the *Engineering News-Record* of May 26th. The original article includes some illustrations which add to the impressiveness of the operation, but the descriptive matter is fairly complete in itself.

Sixth-street Bridge across the Allegheny River at Pittsburgh was ordered to be removed by the War Department several years ago as an obstruction to navigation, its headroom and clearance width being insufficient to accommodate the increased traffic on the Allegheny River. The removal order included also two other downtown bridges, at Seventh and Ninth-streets. These latter were rebuilt during the past two years, the old structures being taken down and scrapped. Sixth-street Bridge, the last of the three to be renewed, had a superstructure that was considered still suitable for lighter service, and the county therefore decided to remove it some miles downstream and re-erect it as a highway bridge across the back channel of the Ohio River between Neville Island and Coraopolis.

Accordingly, the Department of Public Works of Allegheny County, under Norman F. Brown, director, contracted with the Foundation Company to remove the bridge from its present site and re-erect it at Coraopolis. It was decided to accomplish the removal by floating the spans integrally on scows.

The bridge consists of two spans, each 440ft. long, 44ft. wide, 80ft. high, weighing 1600 tons each. The south span was taken in hand first ; the north span will follow.

In order to lower the spans to the scows on which they are to be floated, the contractor designed a steel tower capable of carrying the ends of both spans at the centre pier, and a similar tower for the south end of the south span, the latter to be subsequently moved to the north end of the north span. The towers were erected by cutting recesses in the stone masonry and transferring the load from the shoes to the tower. After the load had been transferred to the steel tower the masonry was removed and the bridge was ready for lowering.

Each shoe was supported on four tension plates or steel straps, 18in. by 1in., 47ft. long, punched with twenty-six holes 7in. in diameter and 15in. from centre to centre ; the spacing of the holes was made to correspond with the run-out of the jacks. The jacks bore against a billet, which in turn bore against one of the steel pins passing through the straps.

After the load was taken by the jacks, a lower pin was removed and the jacks were allowed to bleed until the next hole could be caught down below and pinned off. The jacks were then further released and the billet and upper pin moved up 15in., to the next hole. The lowering operation was thus repeated, hole by hole, until the span rested on the barges.

Four 500-ton hydraulic jacks were used in the operation.

The span was lowered on to four steel barges, each of 1000 tons capacity, fastened together in pairs and placed longitudinally with the span. Blocking was placed on the steel girders that fastened the barges together, at each panel point of the span, so that the span rested at 42 points. In this nest of blocking there were set ordinary screw jacks of 40 tons capacity, to be used subsequently in relieving the tension in the top-chord pins.

After the span was loaded on the barges, which took one day, it was moved endwise so that the shoes cleared the centre pier tower, and then swung downstream, where steamboats took hold of it and towed it to the north shore of the Allegheny River above Manchester Bridge.

On account of the fact that there is not sufficient clearance under either the Manchester Bridge over the Allegheny or the Ohio Connecting R.R. Bridge over the Ohio River, to pass the span, it will be necessary to take off a portion of the top chord so as to decrease its height and enable it to pass under the bridges. This method was decided upon as being safer than an attempt to submerge the barges, and will be probably a cheaper method in view of the fact that two bridges must be passed. The span is to be transported down the Ohio, passing under the two bridges mentioned, through the Emsworth Lock, and up the back channel of the Ohio, and placed in position on new piers which have been built for its reception, at the crossing from Neville Island to Coraopolis.

As soon as the present span is placed on its foundation at Coraopolis, the barges and blocking will be brought back to Sixth-street to receive the north span, and the process described will be repeated.

CUTTING UP A LARGE IRON CASTING.

AN interesting cast iron cutting job was recently carried out by the oxy-acetylene process in the shops of a Yorkshire ironworks by a representative of Allen-Liversidge, Ltd. The casting to be "scrapped" was originally intended for the top portion of a large press and weighed 17 tons. In the course of its manufacture, owing to some error, insufficient vent holes had been provided in the mould, and, in consequence, some of the sand cores were destroyed, the sand becoming mixed up with the cast metal. In addition, the "chaplets" used in the moulding were in somewhat unusual places. These two factors, together with the existence of a large number of blow-holes, accentuated the difficulties met with in the cutting.

The casting, after examination, was found quite unfit for delivery, and it was therefore decided to scrap it and cut the loss involved. Scrap cast iron, however, fetches about £4 per ton, so that if the casting could be broken up at a reasonable cost into pieces of such a size as to be easily handled, some "salvage" out of the loss to the firm might be obtained, since the value of the metal at £4 per ton was £68. The usual method adopted for breaking up faulty castings is, of course, "tupping." In this case, however, it was considered that without some previous modification of the structure of the casting, "tupping" would be ineffective. Indeed, parts of the metal were as much as 14in. thick. The Hull branch of Allen-Liversidge, Ltd., was therefore applied to, and a demonstrator was sent to the works with supplies of dissolved acetylene and a "Universal" cast iron cutting blow-pipe.

It was decided to cut the casting in half latitudinally, and to make several additional cuts in the thicker portions of each half. The two halves were then to be separately "tupped." Immediately cutting started, it was apparent that the work was going to be far from easy. The presence of much moulders' sand and many blow-holes in the cast iron caused a constant series of small explosions, which hindered operations, and the action of the cutter was further retarded whenever there was a "chaplet" in the line of the cut owing to the air space, however minute, between the surface of the chaplet and the base metal. Despite all the difficulties, however, the job was successfully completed, and on its conclusion the casting was easily "tupped." In all, 22 lineal feet of metal, of thicknesses varying from 4in. to 14in., and averaging 9½in., were cut, the time occupied being 6½ hours of actual cutting. Apart from that, the only other work involved was occasional changing over from one battery of dissolved acetylene and oxygen cylinders to another, and the use of the crane for changing the position of the casting. The consumption of gases was :—dissolved acetylene 750 cubic feet, and oxygen 3600 cubic feet.

Inclusive of the welders' and workmen's time, the use of the crane, and cost of gases, the total cost of the demolition of the casting was, we understand, about £20. The firm concerned therefore saved some £48.

SIXTY YEARS AGO.

THE attitude of the established engineering institutions towards the formation and development of new societies provided a subject of controversy sixty years ago, just as it does to-day. In our issue of July 26th, 1867, we find a leading article devoted to the policy of the Institution of Civil Engineers towards a newcomer, the Society of Engineers. That society had been in existence for ten or twelve years, and boasted several hundred members. With the growth of its numbers and bank balance, the society sought to be legally incorporated by royal charter. The Institution, however, interfered, and endeavoured to impose its veto on the proposed step. We felt constrained, in spite of the respect we entertained for the Institution, to criticise its action in this matter. We pointed out that it itself obtained the privileges attaching to incorporation when it had less than a dozen members, and that it could not arrogate to itself a monopoly of these privileges. It could not, we continued, be argued that the Institution was all-sufficient for the profession. Comprehensive though its interests were, it did not do for engineers what the College of Surgeons did for the medical faculty or what the Bar did for the legal profession. It prescribed no curriculum, held no examinations, granted no diplomas, conferred no degrees. It could neither make an engineer nor mar one. There were as clever engineers outside its pale as within it. Non-membership of the Institution was neither a dishonour nor a professional disqualification. Since its incorporation it had not made the slightest effort to ameliorate the somewhat anomalous position in which the profession had always stood, yet it was now seeking to oppose the attempt of a younger society to participate in benefits and privileges largely of a legal kind which it itself enjoyed. The case was argued before the Duke of Richmond. Much was made by the Institution of the alleged similarity in the names of the two bodies, but on this point we expressed the view that if any change of title were really necessary in order to avoid confusion, it was the Institution which should make the alteration, for its title was a complete misnomer, in so far as it implied that none but civil engineers were admissible to membership. Bearing in mind that the age of monopolies was gone, and that equal participation in right of privileges and the extension of the franchise were becoming general, we found that neither justice nor fair play was on the side of the Institution. In the same issue we published a letter drawing attention to the benefits to be obtained by young engineers from membership of the Civil and Mechanical Engineers' Society, a body established in 1859 to meet the needs of those who were still too young to join the Institution of Civil Engineers, for in those days the Institution had no "student" class in its membership. The Society of Engineers still exists under that title, and has absorbed the Civil and Mechanical Engineers' Society.

The Design of Boiler Furnaces.*

By W. J. WOHLENBERG and F. W. BROOKS.

THE particular phases of the design of boiler furnaces which are considered in this paper may be outlined as follows :—

(1) The influence of the extent of water wall surface exposed to furnace radiation on the heat absorption efficiency of the steam generator as a whole.

(2) The influence of the extent of water wall surface exposed to furnace radiation on the permissible rates of energy release for a given limiting furnace temperature.

(3) The influence of the extent of water wall surface exposed to furnace radiation on the permissible range of load variation for given limiting high and low furnace temperatures.

(4) The influence of refractory coating on the furnace

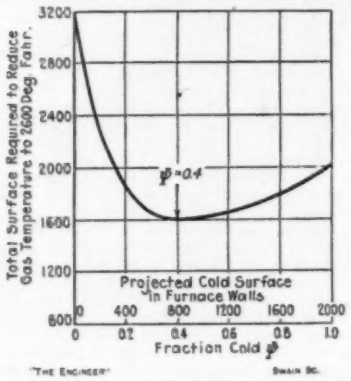


FIG. 1—INFLUENCE OF FRACTION COLD ON TOTAL SURFACE REQUIREMENT

water wall on the conditions outlined under (1), (2) and (3).

The mean temperature of energy release in the boiler furnace is the result of—

(1) The rate of energy input to the furnace.

(2) The rate of energy discharge to the furnace walls.

(3) The rate of energy absorption by the gases within the furnace.

The first quantity is determined by the rate of burning fuel plus the energy brought in by the air supporting combustion. The second quantity is largely influenced by the character of the furnace walls, *i.e.*, the extent of the water wall and refractory surfaces of the furnace envelope. The third quantity is determined by the thermal capacity of the resulting gaseous mixture.

FUNCTION OF THE WATER-COOLED FURNACE WALL.

The influence of water wall surface exposed to furnace radiation on the heat-absorbing efficiency has recently been the subject of some investigation, and the term "fraction cold, ψ," has been introduced in a paper† presented before the 1926 annual meeting of the society. Under these conditions, the total surface requirement for a 2600 deg. Fah. gas temperature is 1630 square feet, whence the difference, 1630 − 800 = 830 square feet, is placed in the convection zone.

The following important conclusions may be drawn concerning the real function of extended water wall surfaces in furnace envelopes :—

(*a*) A considerable extension of the water wall area in furnace envelopes over and above that representing the best fraction cold does not result in a reduction of the total heating surface requirement for given conditions as to rate of energy release and combustion. On the contrary, it generally results in an increase of the total surface requirement for a given final escaping gas temperature.

(*b*) When water-cooled furnace walls occupy a considerable part of the furnace envelope they really serve to permit of an increase in the rate of energy release for a given furnace temperature. The permissible increase in the rate of energy release is such that the average rate of heat absorption per square foot of total heating surface is considerably greater than it would be at the lower permissible rate of energy release with the partially cold furnace, in spite of the more favourable surface distribution in this respect under the latter arrangements.

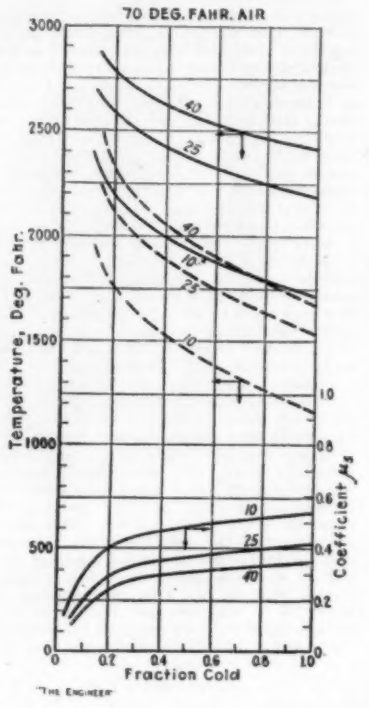


FIG. 2

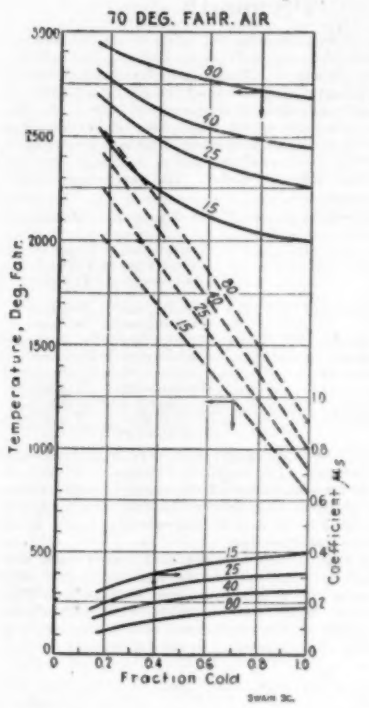


FIG. 3

T_U, solid curves at top ; T_R, dotted curves ; μ_s, solid curves below. Numbers on curves indicate rates of energy release in thousands of B.Th.U. per cubic foot per hour.

INFLUENCE OF FRACTION COLD ON MEAN FLAME TEMPERATURE, ETC.

As the result of the application of an analytical method to numerous cases under different conditions, considerable data on the mean flame temperature and the fraction of the released energy which is absorbed by the furnace walls. The method of computing the mean refractory temperature is also included. Some of these data are now applied in an attempt to arrive at a fair quantitative estimate of what may be the results of varying amounts of water wall surface.

It may be argued that the mean temperatures yielded by any methods of analysis with the above basis are not fairly representative of furnace conditions. Some local hot spots may be unavoidable, and will always have to be specially provided for. The variations of mean temperatures are, nevertheless, important indicators of what may be expected in furnace performance, and a theoretical analysis which yields information of this nature may serve as an important guide in establishing what should and what should not be done. With this in mind, the following quantities are defined :

T_U = radiation mean temperature of gases in furnace. It is also the mean temperature of the gases escaping from the furnace.

T_R = mean temperature of the inner surface of refractory walls.

μ_s = energy which is absorbed by the furnace walls expressed as a fraction of released energy.

The fuels and combustion conditions are taken as

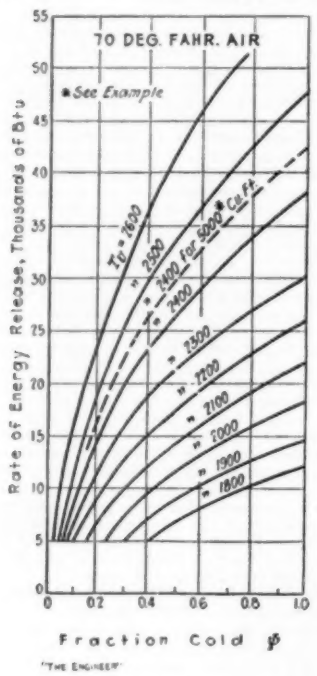


FIG. 4

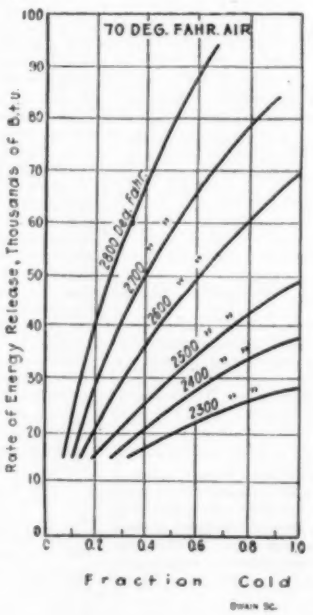


FIG. 5

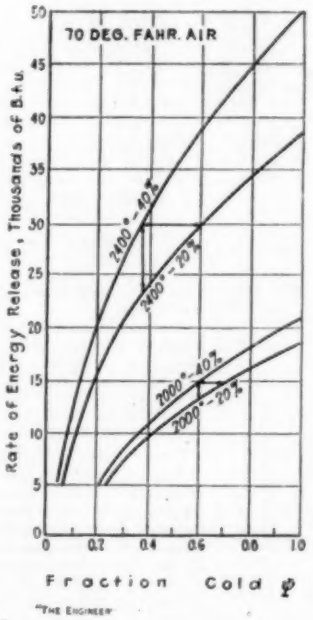


FIG. 6

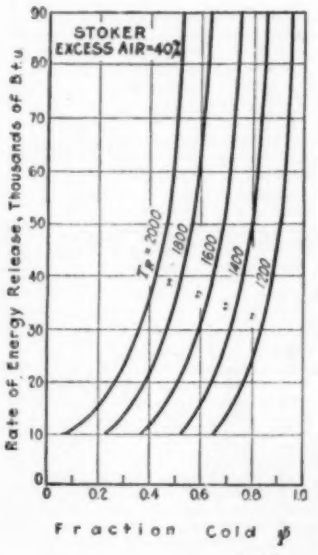


FIG. 7

FURNACE-FLAME AND FURNACE-REFRACTORY ISOTHERMS

FURNACE-FLAME ISOTHERMS

Fraction cold is the fractional part of the furnace envelope which is occupied by water wall surfaces. Fig. 1 shows how, for the conditions indicated, the total surface requirement for a given final gas temperature varies with the fraction cold. The least requirement in total surface results when it is about four-tenths or when 800 square feet of surface is placed in the furnace envelope.

QUANTITATIVE INFLUENCE ON PERMISSIBLE RATE OF ENERGY RELEASE OF EXTENSION OF BARE WATER WALL SURFACE.

In the paper by Wohlenberg and Lindseth are included,

* From a paper presented at the Tri-State Power Meeting of the Power Division and the Erie Section of the A.S.M.E., June 3rd and 4th, 1927.

† Wohlenberg and Lindseth, "Trans.," A.S.M.E., Vol. 48 (1926), page 849.

given in Tables I. and II. for all cases here considered.

TABLE I.—*Coals.*

	Coal No. 1. Ill. Bit., Saline Co.	Coal No. 2. McDowell, W. Va.
B.Th.U. per lb.	12,800	14,500
Moisture, per cent.	6·0	3·00
Volatile, per cent.	32·4	13·00
Fixed carbon, per cent.	54·3	78·80
Ash, per cent.	7·3	5·23
Ultimate Analyses.		
Carbon, per cent.	71·6	82·84
Hydrogen, per cent.	5·3	4·46
Oxygen, per cent.	12·8	5·94
Sulphur, per cent.	1·7	0·48
Nitrogen, per cent.	1·3	1·05
Ash, per cent.	7·3	5·23
Approximate ash-fusion point, deg. Fah.	2,000	2,500

TABLE II.—*Products of Combustion.*

	Per cent. air.	Coal No. 1.	Coal No. 2.
Air per pound of coal	120	11·58	13.10
	140	13·51	15·28
*CO_2 in flue gas, per cent.	120	14·23	14·72
	140	12·27	12·67
*H_2O in flue gas, per cent.	120	6·32	4·74
	140	5·45	4·09
O_2 in flue gas, per cent.	120	3·31	3·34
	140	5·70	5·76

* Percentages CO_2 given in this table as they would appear without condensation of H_2O as is the case in ordinary Orsat analysis.

The results shown in curve form are all based strictly on a furnace of 8000 cubic feet volume and coal No. 1. Larger furnaces than that used will result, for the same conditions otherwise, in a slight increase of the temperatures shown, and smaller furnaces in a decrease of these temperatures.

The curves, Figs. 2 and 3 illustrate how the mean flame and refractory temperatures and the coefficient μ_s vary with the fraction cold for different energy release rates and constant air temperature. Fig. 2, 20 per cent. excess air, is for pulverised, and Fig. 3, 40 per cent. excess air, for stoker-fired furnaces. It is to be noted in particular, as the fraction cold approaches unity, that the refractory temperatures approach temperatures considerably above that of the water cooled wall, in spite of the fact that in the limit no refractory is present. At the limit these curves, of course, actually break sharply, descending to the cold-wall temperatures. Just inside of this point the mean temperatures assume the indicated values, because obviously even a square foot of refractory surface will, due to its low conductivity and because of the radiation of energy to it, assume a temperature considerably above that of the cold wall.

Furnace Flame and Refractory Isotherms.

The furnace flame isotherms for the same conditions as before, shown in Figs. 4 (pulverised) and 5 (stoker), are particularly useful in showing how the permissible rate of energy release for a given limiting ash fusion may be increased, if the fraction cold ψ is increased. It is noticed in all cases, if, for example, the fraction cold is increased from 0·2 to unity, that the permissible rate of energy release for a given flame temperature may be more than doubled. This is the particular advantage gained by use of the water-cooled wall.

The influence of excess air on the placement of the flame isotherms is shown in Fig. 6. The magnitude of this influence decreases as the air temperatures are increased, but for a given air temperature it increases for the higher flame temperatures. Even for air at a temperature of 70 deg. Fah., the permissible increase in energy-release isotherms, form the kind of data most useful in determining furnace proportions and kinds of refractory materials to be used. These, as the flame-temperature isotherms, may be plotted from such data as are shown in Figs. 2 and 3.

Application of the Data.

Let us consider that coal No. 2 should be burned in the pulverised form with 20 per cent. excess air and that a total hourly energy release of 200 million B.Th.U. is required. The ash fusion temperature of this coal is 2500 deg., whence 2400 deg. might be a safe maximum mean flame temperature. For an air temperature of 70 deg., we find from Fig. 4—

For $\psi = 0{\cdot}4$, maximum energy-release rate = 24,000 B.Th.U.

For $\psi = 1{\cdot}00$, maximum energy-release rate = 36,000 B.Th.U.

Hence the required furnace volumes are—

For $\psi = 0{\cdot}4$, $\frac{200 \text{ million}}{24 \text{ thousand}} = 8430$ cubic feet.

For $\psi = 1{\cdot}00$, $\frac{200 \text{ million}}{36 \text{ thousand}} = 5560$ cubic feet.

Curves given by Wohlenberg and Lindseth indicate that rate for an increase from 20 to 40 per cent. excess air is small compared to that which would result should the fraction cold be increased from, say, two-tenths to four-tenths. Obviously, then, the furnace designer should proportion his furnace walls for desirable combustion conditions by including the proper amount of cold surface. A reasonable variation of excess air may then be looked upon primarily as a controlling variable in the operation of the furnace, but not as a cure-all that the designer may eventually fall back upon in operation to correct the mistakes of poor design at the outset.

An example of a furnace refractory isotherm is shown in Fig. 7. Such isotherms, together with the furnace-flame mean flame temperatures in the 5560 cubic foot furnace will be about 50 deg. lower than in the 8000 cubic foot furnace. The net effect of volume on the position of the isotherm in chart, Fig. 4, is shown by the dotted 2400 deg. curve for a furnace volume of 5000 cubic feet. The corrected permissible energy rate for the furnace of symmetry $\psi = 1{\cdot}00$ is thus 42,000 B.Th.U., whence the corrected furnace volume is—

$$\frac{200 \text{ million}}{24 \text{ thousand}} = 4860 \text{ cubic feet.}$$

This is sufficiently close to 5000 cubic feet, so that results for a 5000 cubic foot isotherm may be used without further adjustment. The difference in volume between the 8430 cubic foot furnace of symmetry ($\psi = 0{\cdot}4$), and an 8000 cubic foot furnace is small enough to have practically no influence on flame temperatures, whence no correction is required. In general, the larger the furnace the less the results are influenced by differences in furnace volume.

The maximum permissible rates of energy release in the two furnaces for a 2400 deg. flame temperature are now 24,000 and 42,000 B.Th.U. At one-fourth of this rate of energy release the results are, by reference to Fig. 4, seen to be—

For $\psi = 1{\cdot}00$,

$\frac{42{,}000}{4} = 10{,}500$ B.Th.U.

$T_v = 1720$ deg. Fah.

And for $\psi = 0{\cdot}4$,

$\frac{24{,}000}{4} = 6{,}000$ B.Th.U.

$T_v = 1850$ deg. Fah.

Thus when two furnaces, one with some refractory wall

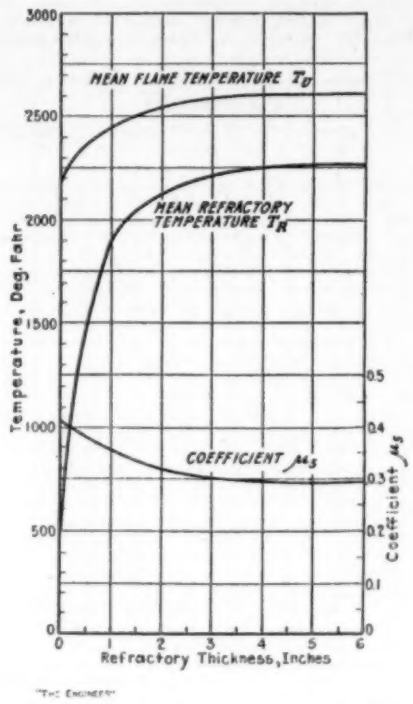
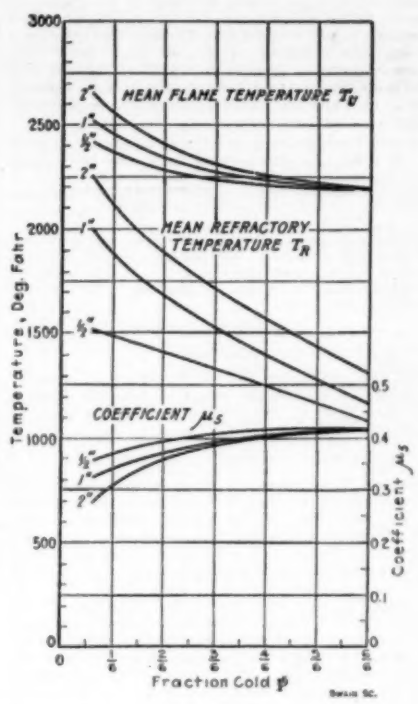
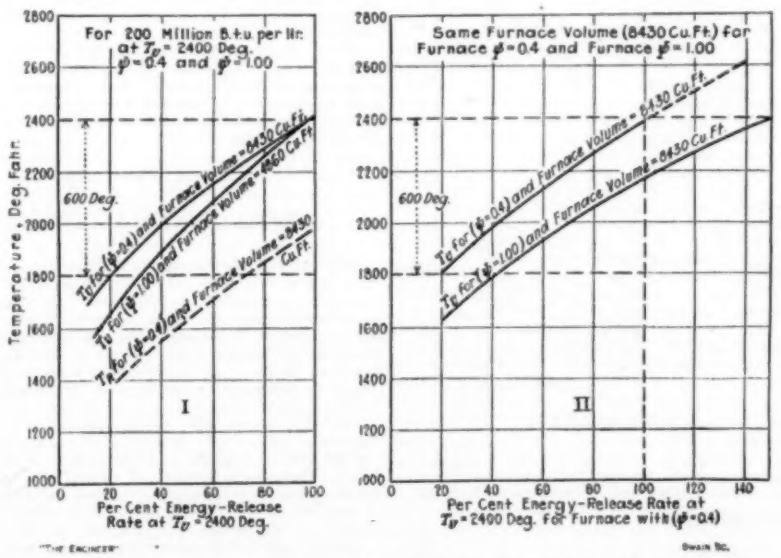


FIG. 9
EFFECT OF VARYING THICKNESS OF REFRACTORY



Furnace No. 2; 25,000 B.Th.U. per cubic foot per hour; 70 deg. Fah. air. Conductivity K = 10.

FIG. 10
EFFECT OF VARYING FRACTION COLD


For 200 Million B.t.u per Hr. at T_V = 2400 Deg. ψ=0.4 and ψ=1.00
600 Deg.
T_V for (ψ=0.4) and Furnace Volume = 8430 Cu.Ft.
T_V for (ψ=1.00) and Furnace Volume = 8430 Cu.Ft.
T_R for (ψ=0.4) and Furnace Volume = 8430 Cu.Ft.
I
Per Cent Energy-Release Rate at T_V = 2400 Deg.
Same Furnace Volume (8430 Cu.Ft.) For Furnace ψ=0.4 and Furnace ψ=1.00
T_V for (ψ=0.4) and Furnace Volume = 8430 Cu.Ft.
T_V for (ψ=1.00) and Furnace Volume = 8430 Cu.Ft.
II
Per Cent Energy-Release Rate at T_V = 2400 Deg. for Furnace with (ψ=0.4)
Temperature, Deg. Fahr.

Coal No. 2, pulverised; excess air, 20 per cent.; air temperature, 70 deg. Fah.; maximum flame temperature = 2400 deg.; temperature range (2400 — 1800) = 600 deg.

FIG. 8—VARIATION OF LOAD RANGE AND CAPACITY WITH CHANGE IN TYPE OF FURNACE ENVELOPE

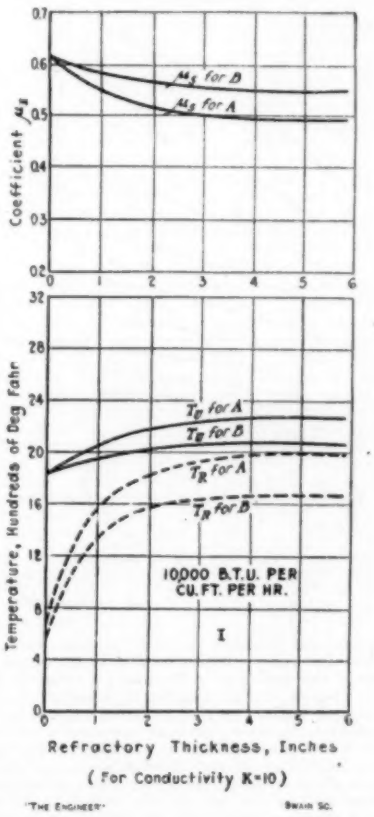


FIG. 11—EFFECT OF VARYING THICKNESS OF REFRACTORY

area and the other with none, are proportioned for the same total energy release, B.Th.U. per hour, at a given maximum flame temperature and remaining conditions the same, the mean flame temperature falls off more rapidly with decrease in load in the furnace cavity whose envelope

is occupied totally by bare water wall surface. This condition obviously has an important bearing on the permissible range of load variation for a given permissible range of variation in mean flame temperature.

By utilising the flame and refractory isotherms of Figs. 4 and 7, the flame and refractory-temperature characteristics for the foregoing set of conditions are plotted, with the results shown in Fig. 8. On Chart I. are shown the resulting temperature characteristics of the design for a given limiting flame temperature at a given total energy release rate, B.Th.U. per hour. In Chart II. are shown the results as to flame temperature characteristics when the same furnace volume is employed for both the symmetry $\psi = 0{\cdot}4$ and the symmetry $\psi = 1{\cdot}00$, with other conditions as indicated. Inspection of these figures will bring out the following facts, if we assume, for example, the limits of high and low flame temperatures respectively as 2400 deg. and 1800 deg.—

CHART I., FIG. 8.—*200 Million B.Th.U. per Hour at 2400 deg.* (T_V).
For $\psi = 0{\cdot}4$, furnace volume = 8430 cubic feet and load at 1800 deg. = 20 per cent. of load at 2400 deg.
For $\psi = 1.00$, furnace volume = 4860 cubic feet and load at 1800 deg. = 31 per cent. of load at 2400 deg.

CHART II.—*Furnace Volume = 8430 cubic feet for Both Furnaces.*
Maximum energy released in furnace of symmetry $\psi = 1{\cdot}00$ at 2400 deg. is equal to 150 per cent. of that released when $\psi = 0{\cdot}4$ at 2400 deg.
For symmetry of $\psi = 0{\cdot}4$, load for 1800 deg. = 20 per cent. of that at 2400 deg.
For symmetry of $\psi = 1{\cdot}00$, load for 1800 deg. $= \frac{40}{150} \times 100$ = 27 per cent. of that at 2400 deg.

Obviously, the symmetry ($\psi = 1{\cdot}00$) is of a necessity one in which the economical range of load variation is narrower than it is in the furnace provided with some refractory wall surfaces.

REFRACTORY COATED WATER WALLS.

In order not to sacrifice too much in the way of permissible capacity at the high limit of furnace temperature while at the same time improving the conditions at the low limit of furnace temperature, it appears to have been found advantageous to use a refractory coated water wall in place of either the uncooled refractory or bare water wall.

An example of the influence of the thickness of the refractory coating on furnace conditions is shown in Figs. 9 and 10. The water wall furnace in this analysis is considered as one in which the top face of a cubical cavity presents bare water tubes. The other faces are considered as plane metal surfaces cooled by water in the boiler circulation and covered on the interior plane surfaces with a refractory coating of the thickness shown. The conductivity of the refractory is taken as 10 B.Th.U. per square foot per degree difference per inch of thickness, which is a fair average for the ordinary refractory materials. Carborundum has a very much higher conductivity and the curves may be applied also for such cases simply by multiplying the refractory thickness shown by the ratio of conductivity of the refractory under consideration to that for which the chart was constructed. Thus, if the conductivity should be 50, the same furnace conditions, as shown in the figures, result when the refractory of higher conductivity is 50/10, or five times as thick.

The general shapes of the various curves shown in Figs. 9 and 11 are practically the same for all cases. Their magnitude and relation to each other, though, varies considerably. The extreme left-hand end of all curves represents the type $\psi = 1$ furnace conditions; that is, for the furnace cavity completely surrounded by bare water-cooled walls. In general, the temperature curves rise quite rapidly to a practically constant value, so that by the time the 6in. refractory thickness is reached, the furnace conditions are not at all dissimilar to what they would be if the refractory wall were much thicker and had no water wall back of it. In other words, for a conductivity of 10 the water cooling of the refractory has very little effect as far as thermal advantage is concerned after a thickness of even 2in. is reached. If the conductivity is 50 the wall thickness might be increased to 10in. before the effect on furnace conditions becomes negligible. The lower group of curves in each of the charts, Fig. 11, shows how the conditions are altered if two faces of the cubical furnace cavity, instead of one, present bare iron water-cooled fronts, the remaining four walls being water-cooled refractory lined and of the refractory thickness shown. The influence of fraction cold for a given set of furnace conditions otherwise is well illustrated by Fig. 10.

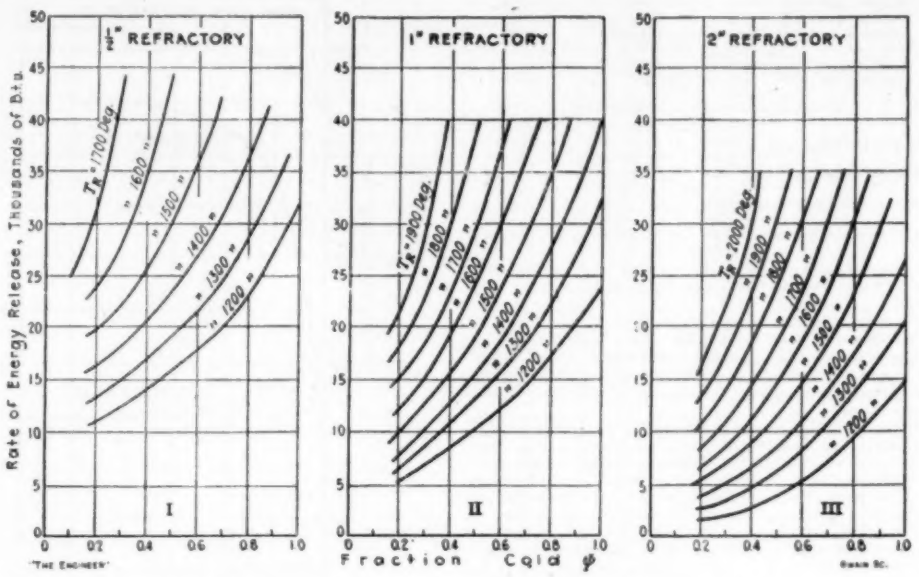
FURNACE ISOTHERMS AND THEIR APPLICATION.

The charts of mean flame temperature isotherms shown in Fig. 12 indicate how much the influence of change in fraction cold on permissible rate of energy release is decreased as the refractory thickness is decreased. Thus, for a ½in. refractory a furnace with symmetry $\psi = 0{\cdot}2$ permits, for the conditions shown, of an energy-release rate of 23,000 as against 30,000 B.Th.U. for the type E furnace symmetry. If the refractory thickness is increased to 2in., the permissible energy-release rate for furnace symmetry $\psi = 0{\cdot}2$ is decreased from 23,000 to 16,000 B.Th.U., thus requiring an increase in furnace volume in the ratio of 23,000/16,000.

The furnace refractory isotherms—Fig. 13—indicate in a similar manner how the mean refractory surface temperatures change with thickness of refractory. Thus, for an energy-release rate of 20,000 and symmetry of $\psi = 0{\cdot}4$, the refractory temperature varies from 1400 deg. for ½in. thickness to 1850 deg. for 2in. refractory thickness.

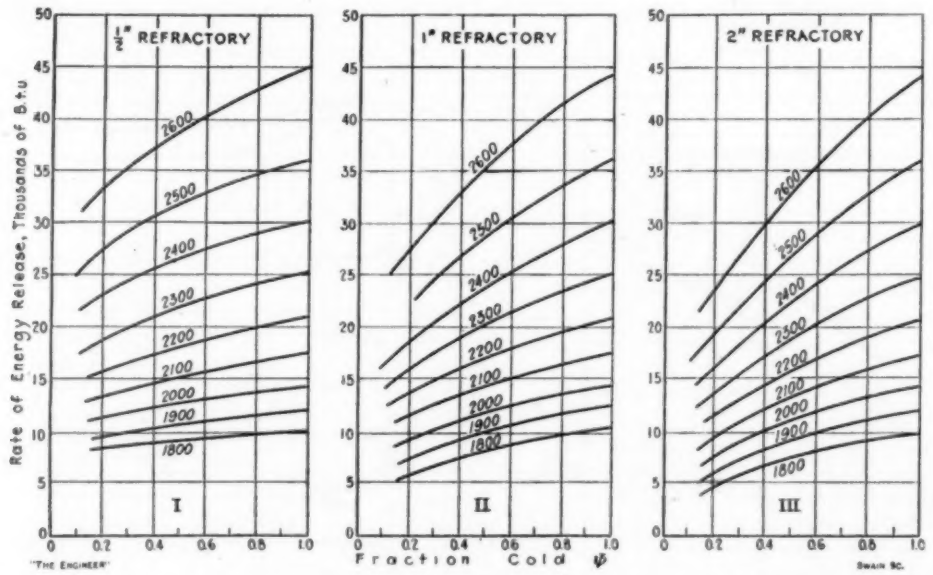
Thinning down of the refractory coating, as was to be expected, has the effect of narrowing the limits of economical load variation. At the same time, however, it has a decided influence on the required furnace volume.

In none of the cases has anything been said of the limitations which may be imposed on the possible rates of energy release by the methods employed in burning the coal, or how this may affect the comparisons which have been drawn. Obviously, if conditions in this respect are such as to make it uneconomical because of some factors other than ash fusion points, such, for instance, as the loss of too much unburned carbon with the flue gases, then the apparent volume advantage which the $\psi = 1$ envelope has may be considerably decreased. Not only this, but the permissible load range of the $\psi = 1$ furnace is still further reduced because now its maximum rate of energy release has been lowered, and, furthermore, without any change in the lower limit of energy-release rate.



Coal No. 1 or No. 2, pulverised; excess air, 20 per cent.; air temperature, 500 deg. Fah.; conductivity, K = 10. For any conductivity multiply refractory thickness shown by K/10.

FIG. 13—FURNACE REFRACTORY ISOTHERMS



Furnace No. 2; coal No. 1 or No. 2, pulverised; excess air, 20 per cent.; air temperature, 500 deg. Fah.; mean flame temperature T_F indicated on curves. Conductivity, K = 10. For any refractory conductivity multiply thickness shown by K/10.

FIG. 12—FURNACE-FLAME-TEMPERATURE ISOTHERMS

CONCLUSIONS.

(1) The $\psi = 1$ furnace envelope provides for the highest permissible rates of energy release in so far as flame temperatures are the limiting factors.

(2) Furnaces provided with properly designed refractory-lined water walls provide conditions in which the energy-release rates of the $\psi = 1$ furnace envelope may be approached, in so far as flame temperatures are the limiting factors. They provide better conditions for the completion of combustion, at least in the lower ranges of load.

(3) Furnace envelopes of interior symmetry identical with that of the refractory-lined water wall furnace, but in which the refractory walls are not cooled, require the greater volume of the two for given limiting mean flame temperatures. If the fraction cold ψ is not large for these, the provisions for efficient combustion at the lower ranges of load are fully as good as they are in the refractory-lined water wall furnace. If, however, the fraction cold of the former is increased to yield an energy rate on a par with that of the latter, the actual interior area of the refractory wall is likely to cover only a relatively small portion of the total envelope. In the latter case the combustion conditions at the lower ranges of load may be deficient. This is particularly so if the refractory portions are not properly located.

(4) In view of the importance of the information furnace by such an analysis, and because of the dearth of data from experiments on the boiler furnace which might serve as reference points, it becomes obvious that there is a need for a thorough experimental research in the field of radiation and heat transfer in boiler furnaces as related to combustion conditions.

(5) Comparisons made by such an analysis as this are probably justifiable because of the care that has been taken in having all factors reduced to a comparable basis, but whether the whole scene should be shifted up or down will probably not be known until more data from experiment are made available.

CANADA'S NATURAL RESOURCES.

To a country like Canada, in which the natural resources are being rapidly discovered and turned to useful account, it is only natural that the attention of the engineer should be attracted, and we have perused, month by month, with considerable interest, the *Bulletin* of the Natural Resources Intelligence Service, of the Department of the Interior, Ottawa. As a consequence we can endorse the following paragraph taken from a little leaflet published by the Department:—

"Briefly stated, the whole purpose of the Natural Resources Intelligence Service is to maintain an efficient central bureau respecting Canada's natural resources and to contribute such further aid in promoting their sound development as is naturally associated with the operation of such a bureau. Many of the requests for information—which in the course of a year number many thousands—can be anticipated and met by the publication of maps, reports and pamphlets covering the resources of different areas, the extent of their present industrial use and the conditions affecting their further development. Again, the equipment possessed by the Service—its fund of resources, industrial and commercial data, its geographic and economic mapping facilities, the range of material it is able to bring to bear upon a given question—enables it effectively to meet unforeseen needs and to aid those who from time to time are entrusted with the task of solving acute national problems or of advising upon the soundness of large public undertakings."

CONSIDERABLE disappointment has prevailed in financial circles during the past week by the Metropolitan Railway Company paying an interim dividend of only 1 per cent., as against 1½ per cent. a year ago.

Railway Matters.

THE Government of Ceylon will include provision in the 1927–28 Budget for beginning the delayed extension of the railway to Tangalle.

THE up "Cornish Riviera" has hitherto called at Exeter. It now runs non-stop from Plymouth, North-road—depart 12.30—to Paddington—due 4.45.

THE divisional general manager for the North-Eastern area, London and North-Eastern Railway, has issued a circular to the staff expressing appreciation for the excellent arrangements made for the thirty-seven special trains run for the eclipse and the 16,488 passengers they carried.

THE South African Minister of Railways has stated that the Administration expects to start electric trains on the Sea Point section in July, while the Simonstown service should be inaugurated about March, 1928. The Sea Point line will be used as a training school for the drivers required on the larger section.

THE big engines used on the main line, *e.g.*, on the Torbay Express, have not hitherto been able to work Torquay trains beyond Newton Abbot, owing to the Hoodown Viaduct not being strong enough to carry them. Its reconstruction will, however, now allow for engines to work through. A new 65ft. diameter turntable has been provided at the terminals at Kingswear, in place of the former 55ft. table.

MORE than 1100 workmen and ten trains, with a full complement of equipment, are being used in the rehabilitation and construction of the Hudson Bay Railway, state officials of the Canadian National Railways. The end of steel is now at Limestone River (1 mile 350 yards), and in addition to reconditioning the track which was in existence prior to the beginning of this season's operations, 18 miles of new track have been laid, while nearly 500,000 new sleepers have been placed to date.

THE Ministry of Transport railway statistics for April, which have recently been issued as a Stationery Office publication, price 3s. 6d., show that, compared with April, 1926, there was a decrease of 2·6 per cent. in the number of passenger journeys and of 1·4 per cent. in the receipts from passengers. The passenger train mileage showed an increase of 1·2 per cent. The tonnage of freight carried decreased by 3·7 per cent., but, owing mainly to the increase in some rates as from February 1st, the freight-train receipts showed a decrease of only 1·1 per cent., and, moreover, the freight train mileage suffered a decrease of 2·1 per cent.

WHILST it is a fact it may surprise many to hear that railway companies may not please themselves as to the running of Sunday trains; a refusal to do so in response to a reasonable demand, or the provision of an alleged insufficient service, would render the companies open to a complaint by the Railway and Canal Commission. We make that observation as a consonance of the inquiry addressed by Mr. Thurtle of the Minister of Transport on July 18th:—"Is the Minister aware that since a more rational view has been taken of Sunday there is a strong public demand for better railway services on Sunday?" Colonel Ashley's reply was as indicated above.

THAT, at one time, much abused company the Southern, has recently published some figures as to the punctuality of its passenger trains in April and May last. They show that, excluding the continental trains, 82,376 steam-worked trains ran every week day, of which 74·85 per cent. arrived on time and 20·96 per cent. were not more than five minutes late. The average time late for all the steam trains was 0·86 minute. In May the same average was 0·64 minute. There were 54,643 electrically-operated trains in May, of which 80·84 per cent. arrived on time and 18·24 per cent. were not more than five minutes late. The average for the electric service was 0·42 minute late in April and 0·30 minute in May.

AT the recent annual general meeting of the National Union of Railwaymen, attention was drawn to the large sums of money lost to the companies yearly by claims for goods being damaged by wet, broken, lost or stolen. During the last four years the London, Midland and Scottish Railway alone paid £1,386,000 in settlement of 1,251,795 such claims. The men considered that those claims reflected on themselves, and the annual report said that it was hoped that with increased care in the handling, loading and sheeting of merchandise by the staff and an active co-operation of all grades, there would be an immediate all-round improvement. The meeting, with only four dissentients, agreed to a suitable resolution to the above effect.

WITHOUT any accompanying announcement in the Press the returns of railway accidents and casualties for 1926 were issued the other day as a Stationery Office publication, price 1s. The silence is significant, as it shows how light-heartedly the British travelling public takes its safety—on the railway, at all events. As was anticipated in this column of our issue of January 7th, the number of passengers killed in train accidents was 13. There were three fatal accidents during the year, and only in four years of the present century have there been fewer than three train accidents which involved deaths of passengers. The number of passengers injured in train accidents reached the high number of 765, which is, excepting the extraordinary year of 1915, the highest since 1910, and may be ascribed to no fewer than 345 passengers having reported themselves as being injured in the Gale-street collision—see THE ENGINEER of June 3rd, page 603. There is no better index of safety in railway travel than the number of servants killed in train accidents, as they include goods trains, and, it is gratifying to find that last year only two servants were so killed. That is the lowest figure reported since the Act of 1871 was passed, but three deaths were reported in 1896, and in six years there were only four. There were 159 servants killed and 2882 injured in "movement" accidents, *i.e.*, caused by the movement of vehicles other than in train accidents. These, again, are the lowest recorded; a result, no doubt, in part due to the less traffic consequent upon the coal stoppage. As, however, the number of accidents themselves showed no variation the safety movement may also have been a main factor. For instance, under the three headings that cover accidents to men working or walking on the track there were 75 killed as compared with 136 in 1925.

Notes and Memoranda.

THE wireless section of the U.S.A. Patent Office has doubled in size in the past six or seven years. Applications for wireless patents number approximately 125 per month, as compared with about 60 per month in 1920.

ALTHOUGH high-frequency amplification is primarily intended for the magnification of weak incoming wireless signals, states the *Wireless World*, it must not be forgotten that it has another most important function, namely, the increasing of the selectivity of a receiver. In many instances, it is possible to obtain sufficient sensitivity for the desired reception by using a detector valve with reaction, and probably with a low-frequency amplifier, but such a receiver will always be inferior, from the point of view of selectivity, to one which includes a stage or two of even moderately effective tuned high-frequency amplification.

IN the course of a paper on "The Application of Magnetics to the Inspection of Steam Turbine Bucket Wheels," read by Mr. J. A. Capp before a recent meeting of the American Society for Testing Materials at French Lick, Indiana, U.S.A., the author pointed out that the method of testing involved the indication of defects in the metal by changes which they set up in the reluctance of a magnetic circuit, of which the wheel under test was the variable portion. The indications were obtained by using a galvanometer of high sensitivity, connected to measuring coils, situated in the specially designed pole tips of the electromagnet, between which the wheel was rotated.

A COMPARATIVELY new use of helium, and one that promises to become of very great importance, is its utilisation in the production of artificial atmospheres under which divers and caisson workers carry out their operations. It is anticipated that such atmospheres will permit of much greater depths being reached under water, longer periods being spent without fatigue, and, in the case of tunnel and caisson workers, that the prevention of what is known as "caisson disease" will be facilitated. Investigations along these lines are being carried out by the United States Bureau of Mines, and accordingly considerable impetus has been given to the helium industry, which thus has other outlets besides that of supplying airships with non-inflammable gas.

ELECTRIC power companies have grown to such a size in the United States that there are now eighteen with output of energy exceeding one thousand million kilowatt-hours annually. At the head of the list is the Buffalo, Niagara and Eastern Power Corporation, which in 1926 had an output of 4,464,000,000 kilowatt-hours. This immense volume of power was generated principally by the falling water of Niagara Falls. The Commonwealth Edison Company of Chicago is second, and the Edison United and Allied Companies of New York City third. The Southern California Edison Company is fourth, and the Pacific Gas and Electric Company fifth. There are no fewer than 126 systems in the United States, each of which is generating more than 100 million kilowatt-hours a year.

A MESSAGE from New York states that a new fire extinguisher, which puts out flames by freezing them, was demonstrated recently in the local plant of the General Electric Company of America. The extinguisher is described as being a steel cylinder fitted with a short piece of hose having a funnel type nozzle. The steel cylinder is filled with liquid carbon dioxide, under a pressure of about 1000 lb. per square inch. The turning of a hand valve releases the gas into the hose and nozzle. Then—to quote the words of the message:—"The release of the gas to the atmosphere so chills the gas that part of it solidifies, forming an intensely cold 'snow.' The 'snow,' instead of melting like ordinary snow, changes indirectly from the solid form into gas. This vaporisation process absorbs heat in great quantities from the burning materials, and when the temperature is sufficiently lowered the fire ceases to burn."

A NEW type of electric cord which acts as a push button at any point of its length is, according to *Nature*, coming into use in Berlin in connection with electric bells and buzzers and for starting and stopping machinery. It is the invention of Oscar Nagy, a Hungarian engineer. If the cable is squeezed at any point throughout its length, the circuit is completed and the signalling or operating device is actuated. This is effected by having the wires woven into a loose braid separated by an elastic non-conductor, which, however, makes contact when pressure is applied. It is expected that this device can be usefully employed with complicated machinery where threatened accidents to either operator or material make sudden stopping a necessity. It can be operated also by the knee or the elbow, and so has advantages over ordinary types of switches and push buttons. Hidden beneath carpets it would make a useful burglar alarm. In mines and quarries it could be arranged so that a fall or slide of rock would automatically sound an emergency signal.

THE electric current, states *Shipbuilding and Shipping Record*, yields one of the most convenient methods of operating all manner of recording instruments, not only because of the great degree of accuracy which can be obtained, but because of the facility with which those readings can be recorded in positions remote from the actual position of the instrument itself. One of the most useful of the many electrical recording instruments which are available for use on board ship is the electric depth-recording gauge, by means of which the amount of oil, fresh water or ballast water in any tank can be at once accurately determined. The instrument is operated by means of a small float arranged in the tank itself, and as this float rises or falls it tends to alter a resistance in the electric circuit, the movement of a small electric motor required to balance this resistance giving a measure of the movement of the float. The advantage of the electric depth gauge lies in the fact that not only does it give an exact record of the level of the fluid in the tank at the instrument itself—which is, of course, situated at the tank—but it is possible to have repeater dials placed at any other convenient position in the ship, the connection between the master dial and the repeaters consisting merely of an electric lead. Another feature of the instrument is that recording apparatus can be employed in conjunction with it.

Miscellanea.

THE eleventh Exhibition of Chemical Industries is to be held in the Grand Central Palace, New York, from September 26th to October 1st.

A PLANT, which will cost approximately £11,000, is being put up at Yallourn, by the Victoria State Electricity Commission for the electrical precipitation of the dust produced in the manufacture of brown coal briquettes.

RECENTLY a factory was opened in Leningrad for the production of electric meters. Previously all the electric meters used in Russia had been imported from abroad. The output capacity of the factory is to be 60,000 electric and other meters per annum.

ACCORDING to a recent official return, the imports into India of American electrical machinery during last year attained a value of £146,840, as compared with £124,870 in 1925. There was also an increase in the imports of American electrical fittings and goods—from £147,288 to £237,750.

THE latest discovery of nickel ores in the Transvaal is in the Middleburg district. The ore is associated with platinum and copper, and it may now, says the *S.A. Mining and Engineering Journal*, safely be asserted that nickel-copper, or monel metal, will be an important by-product of the Transvaal platinum industry.

ON July 7th Mr. Hardie asked the Minister of Transport if his attention had been called to the acceptance by a member of the Electricity Board of a directorship in a company the interests and profits of which were dependent upon such schemes as the electricity scheme, and whether he proposed to take any steps in the matter. Colonel Ashley said that the conditions under which the members of the Central Electricity Board might be appointed and might act were laid down in Sec. 1 of the Electricity (Supply) Act, 1926, and he knew of nothing that would warrant intervention on his part in connection with any such case as was referred to.

ACCORDING to the *Ironmonger*, at the Templeborough wire rod mill of United Steel Companies, Ltd., of Sheffield, on June 28th, the fly-wheel of an engine, 30ft. in diameter and weighing 54 tons, burst into several pieces, and caused great damage to the surrounding machinery. One of these pieces was hurled 50ft. into the air, and fell 100 yards away near to a public road. Another, weighing 3 tons, went through the side of the mill shop and dropped upon a railway wagon. One man received injury which is not serious. The accident was one of very unusual character, and it is regarded as almost miraculous that it was unattended by loss of human life. The mill was fully described in THE ENGINEER of June 20th, 1919.

WORK is being continued upon port improvements at Sao Lourenço, Nictheroy, capital of the State of Rio de Janeiro. The shore line of the Bay of Rio is broken by large, deeply indented inlets, shallow curves and sharp promontories. Several large islands fill the upper bay near the eastern shore, and of them a few will be used as coal depôts for the great steamship companies. Obstructing hillocks will have to be removed, the displaced earth being used to fill up low-lying marshy areas. Some 2,000,000 cubic metres have already been moved at a cost of over £225,000; more than 225,000 square metres of fresh building ground has thereby been obtained. New docks are also being constructed and about 1740 kiloms. of additional railway lines will be built, of which 1600 kiloms. will belong to the Leopoldina Railway Company.

THE French Post Office official and engineer, Monsieur Verdan, who in 1924 invented a device which enabled the multiple Baudot apparatus to be applied to wireless by eliminating atmospheric disturbances, is still continuing his experiments. The first trials, in 1925, between Nice and Ajaccio, are said to have been very successful. Later tests between France and Madagascar were, it is stated, equally conclusive, and further experiments have now been carried out between Paris and Algiers. In spite of the violent atmospheric disturbances of the past few weeks the tests have met with success. Hundreds of telegrams have been transmitted and correctly received. As soon as a transmitting station has been constructed at Algiers, a bilateral wireless service will be substituted whenever the ordinary cable service is interrupted. Similar services will be instituted with Tunis and Morocco.

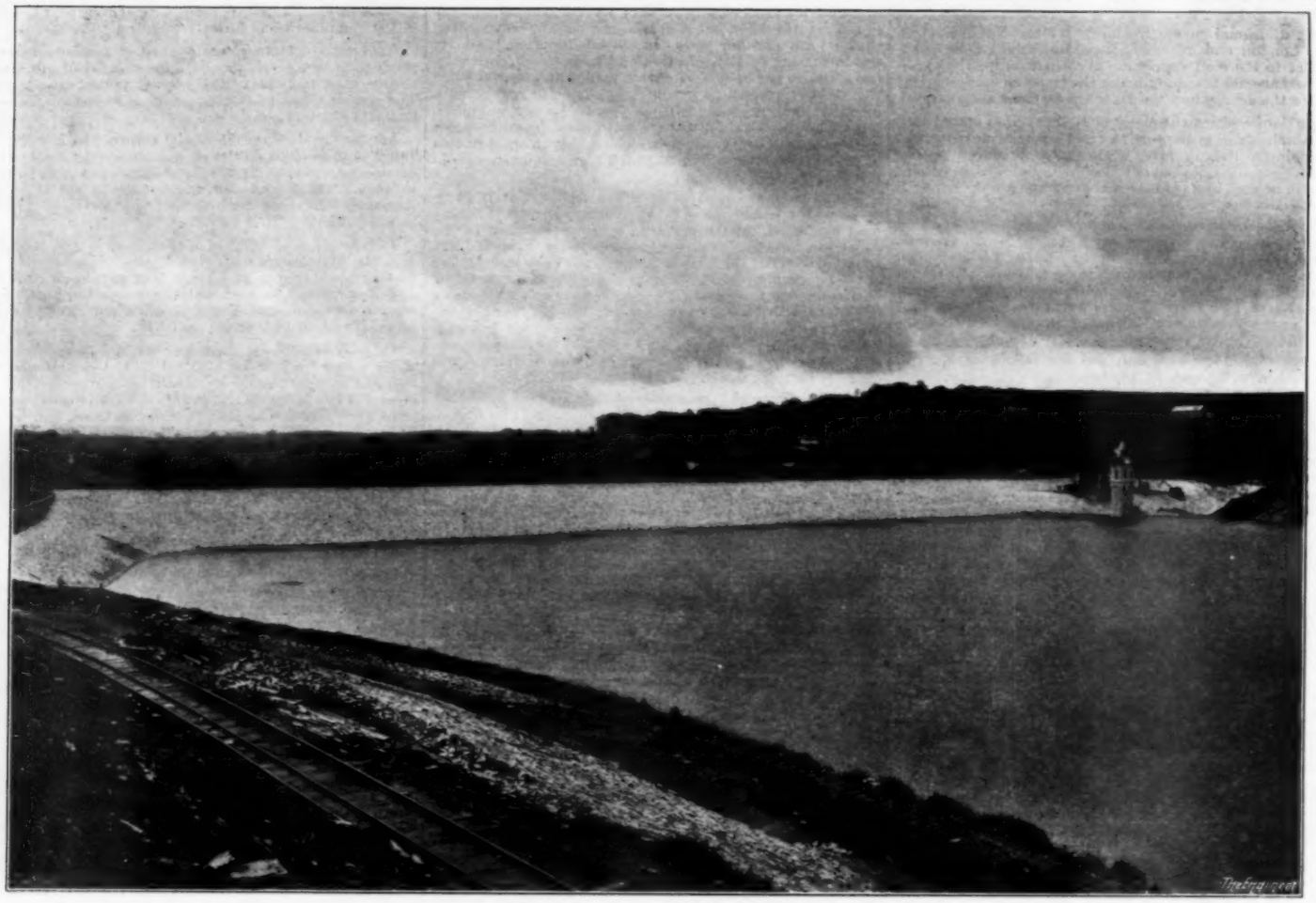
IT is reported from New York that a new burner for marine or industrial use, which can be used for powdered coal, fuel oil or gas, without any alteration of the furnace design, has been developed by the Research Engineering Corporation of that city. The device is the invention of a Mr. D. J. Irish, combustion engineer of the Combustion Service Corporation, who claims that the new burner eliminates all stand-by losses, because oil can be used for starting or manœuvring ships while in port and the pulverised coal can then be turned on merely by shutting one valve and opening another, or both fuels may be used at the same time. Gas also may be used in land installations if it should be deemed desirable. The same air control is used for all three fuels, and either natural or forced draught is possible. One unit installed a year ago in an industrial plant is, it is stated, still in operation without any changes having been made in the original burner equipment.

A SHORT time before the war it was announced at the general meeting of the Suez Canal Company that a fresh source of revenue had become available for the company owing to the beginning of working the manganese deposits in the Sinai Peninsula. The deposits were estimated to contain 3,000,000 tons of ore, and contracts aggregating 1,200,000 tons, spread over ten equal yearly instalments, had already been signed for shipments of the ore to Antwerp and Rotterdam. The preliminary work for developing the mines had already been finished, but the war intervened, and much of the work already done was destroyed in February, 1915. Since the war the ore shipments had increased from 9400 tons in 1918 to 121,000 in 1923, but in 1924 they declined to 105,000 tons, and only 81,900 tons were shipped in each of the following two years, 1925 and 1926. The mines are about 13 miles inland from the coast, and the ore is shipped from the roadstead at Abu-Zénima, some 60 miles south of Suez.

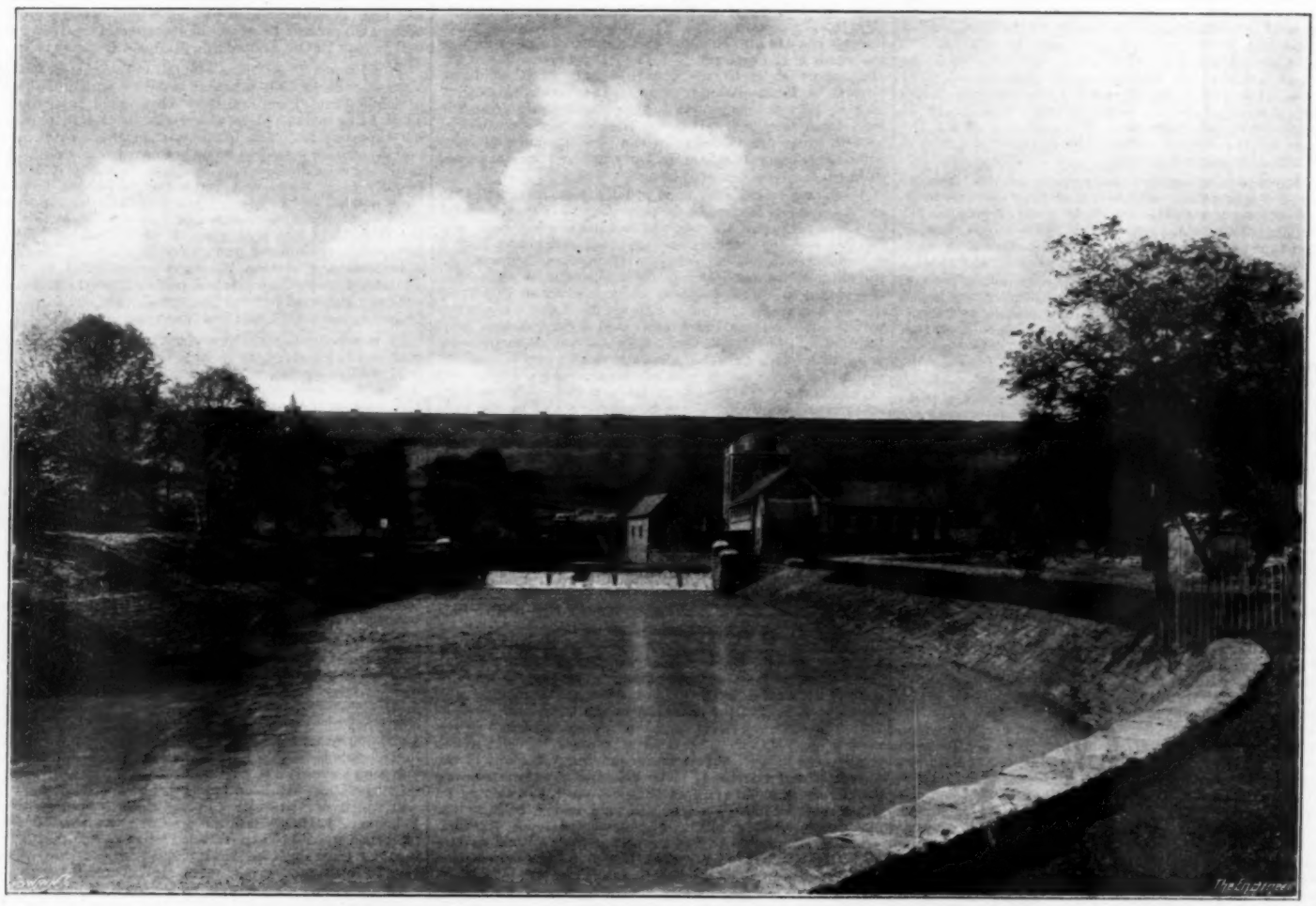
THE TÂF FECHAN RESERVOIR

SIR ALEXANDER BINNIE, SON, AND DEACON, WESTMINSTER, AND MR. T. F. HARVEY, MERTHYR TYDFIL, JOINT ENGINEERS

(*For description see page* 113)



UP-STREAM FACE OF EMBANKMENT, SHOWING VALVE TOWER



DOWN-STREAM FACE OF EMBANKMENT, SHOWING OUTLET TUNNEL AND FILTER HOUSE

The Engineer

Annual Subscription Rates

(including postal charges).

Subscriptions will be accepted by The Publisher direct or through a newsagent at the rates and in the currencies stated below:

BRITISH ISLES	.. ..	£3	5	0	
CANADA	.. .. ..	£3	3	0	Thick Paper edition.
		£2	18	6	Thin Paper edition.
ABROAD	.. .. ..	£3	7	6	Thick Paper edition.
(except Canada)		£3	3	0	Thin Paper edition.

AFRICA	Central News Agency. All Branches	
* £3 7s. 6d.	CAPE TOWN: Wm. Dawson and Sons, Ltd.,	
† £3 3s. 0d.	29-31, Long-street (Box 489)	
	JOHANNESBURG: C. Juta and Co.	
ARGENTINA ..	BUENOS AIRES: Mitchell's Book Store, 576,	
* £3 7s. 6d.	Cangallo	
† £3 3s. 0d.		
AUSTRALIA ..	Gordon and Gotch. All Branches	
* £3 7s. 6d.	MELBOURNE: Robertson and Mullens,	
† £3 3s. 0d.	Elizabeth-street	
BELGIUM ..	BRUXELLES: W. H. Smith and Son, 78–80,	
* Fr. 590	Rue du Marché-aux-Herbes	
† Fr. 550		
CANADA	American News Company. All Branches	
* $15·25	MONTREAL: Gordon and Gotch, Ltd., 334,	
† $14·25	Notre Dame-street, W.	
	TORONTO: Wm. Dawson and Sons, Ltd., 87,	
	Queen-street East	
	TORONTO: Gordon and Gotch, Ltd., 45,	
	Richmond-street, E.	
CEYLON	COLOMBO: Wijayartna and Co.	
* Rs. 44·5		
† Rs. 41·5		
CHINA	HONG KONG: Kelly and Walsh, Ltd.	
* $33	SHANGHAI: Kelly and Walsh, Ltd.	
† $31		
EGYPT	CAIRO: Express Book and Stationery Store,	
* £3 7s. 6d. (Pt. 330)	9, Chareh Maghrabi	
† £3 3s. 0d. (Pt. 308)		
FINLAND ..	HELSINGFORS: Akademiska Bokhandeln,	
* M. 650	Alexandersgatan, 7	
† M. 605		
FRANCE	PARIS: Boyveau and Chevillet, Rue de la	
* Fr. 418	Banque, 22	
† Fr. 390	PARIS: Berger Leverault, 229, Bld. St.	
	Germain	
	PARIS: Brentano's, 37, Av. de l'Opera	
	PARIS: Dunod, 92, Rue Bonaparte	
GERMANY ..	BERLIN: H. Hermanns, Friedrichstrasse 218,	
* R. mks. 70·00	S.W. 48	
† R. mks. 65·00	WESTERN GERMANY: Fritz Rehfus, Blumen-	
	thalstrasse 10, Cologne	
	LEIPZIG: K. W. Hiersemann, Konigstrasse 29	
HOLLAND ..	ROTTERDAM: Hector's Boekhandel, Noord-	
* Fl. 41·00	blaak 59	
† Fl. 38·00	ROTTERDAM: Techn. Boekhandel, "Plan C,"	
	Gelderschestraat 4	
INDIA	BOMBAY: Thacker and Co., Ltd.	
* Rs. 45	CALCUTTA: Thacker, Spink and Co.	
† Rs. 42		
ITALY	MILAN: Ulrico Hoepli	
* Lire 298	ROME: Maglioni and Strini, 307, Corso	
† Lire 278	ROME: Fratelli Treves, Corso Umberto 1,	
	174	
	ROME: Fratelli Bocca	
JAPAN	Maruzen Co. all branches.	
* £3 7s 6d.		
† £3 3s 0d.		
JAMAICA	KINGSTON: Educational Supply Co.	
* £3 7s. 6d.		
† £3 3s. 0d.		
NEW ZEALAND	AUCKLAND: Whitcombe and Tombs, Ltd.	
* £3 7s. 6d.	Gordon and Gotch, Ltd. All Branches	
† £3 3s. 0d.	NAPIER: J. Wilson Craig and Co.	
RUSSIA	LENINGRAD: Mezhdunarodnaya Kniga, Pros-	
* £3 7s. 6d.	pect Volodarsky, 53 A.	
† £3 3s. 0d.	MOSCOW: "Litisdat," Kouznetsky Most, 5–15	
STRAITS SETTLEMENTS	SINGAPORE: Kelly and Walsh,	
* $29·00	Ltd.	
† $27·00		
SWEDEN	STOCKHOLM: A/B Wennergrens Journal-	
* Kr. 61·00	expedition, Stockholm 1	
† Kr. 57·00	STOCKHOLM: A/B C. E. Fritzes Kungl.,	
	Hofbokhandel, Fredsgatan, 2	
SWITZERLAND	BERNE: Joh. William De Groot, Laupenstr. 5	
* Fr. 86·00	ZURICH: Rosa Leibowicz, 4, Ankerstr.	
† Fr. 80·00		
UNITED STATES OF AMERICA	International News Co. All Branches	
* $16·25		
† $15·25		

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-: those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. Central 2256, 2257.

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, July 29th, 1927.

	PAGE
A SEVEN-DAY JOURNAL	111
AN AMERICAN DIARY. No. I. (Illus.)	112
THE TAF FECHAN RESERVOIR AND WORKS. No. I. (Illus.)	113
MAIN LINE RAILWAY ELECTRIFICATION. No. XIX., Italy. (Illus.)	116
INSTITUTION OF NAVAL ARCHITECTS. No. III. (Illus.)	117
B.E.S.A. SPECIFICATION	118
GREAT WESTERN RAILWAY RUNS TO PLYMOUTH	119
MOVING A LARGE BRIDGE	119
CUTTING UP A LARGE IRON CASTING	119
SIXTY YEARS AGO	119
THE DESIGN OF BOILER FURNACES. (Illus.)	120
CANADA'S NATURAL RESOURCES	122
RAILWAY MATTERS	123
NOTES AND MEMORANDA	123
MISCELLANEA	123
LEADING ARTICLES—	
The Geneva Naval Discussions	125
The Theory of Boiler Furnace Design	126
BOOKS RECEIVED	126
A SOUTH WALES POWER TRANSMISSION SCHEME. (Illus.)	127
LETTERS TO THE EDITOR—	
High-pressure Reciprocating Engines	129
British Trade with Finland	130
The Siemens-Benson Critical Pressure Boiler	131
A NEW ALL-METAL FLYING BOAT. (Illus.)	131
ELECTRICALLY DRIVEN PUMPS FOR MARINE AUXILIARY WORK. (Illus.)	132
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	133
Lancashire	133
Sheffield	134
North of England	134
Scotland	135
Wales and Adjoining Counties	135
CATALOGUES	135
PERSONAL AND BUSINESS ANNOUNCEMENTS	135
CURRENT PRICES FOR METALS AND FUELS	136
FRENCH ENGINEERING NOTES	137
BRITISH PATENT SPECIFICATIONS. (Illus.)	137
CONTRACTS	138
LAUNCHES AND TRIAL TRIPS	138

SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

NOTICES TO READERS.

*** *If any Subscriber should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts: correspondents are therefore requested to keep copies.*

The Metallurgist

THE JULY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

JULY 29, 1927.

The Geneva Naval Discussions.

AFTER a week's intermission, due to the recall of the British delegates to confer with the Cabinet, the Geneva Naval Conference is once more in session. Its proceedings to date have not been such as to encourage hopes of a successful outcome, nor is it easy to see how any agreement can be reached on the main issues unless one side or the other makes concessions which have hitherto been rejected as inadmissible. When President Coolidge summoned the Conference, he was careful to explain that his object was to effect naval limitation, not the retrenchment of existing fleets. In other words, he sought to impose a check on the future development of naval armaments without interfering with those already in being. The simplest method of achieving this aim would have been to stabilise the *status quo* in regard to relative strength by an international agreement supplementary to the Washington compact. But it soon became evident that America had a very different end in view. For reasons known only to itself, it had determined to acquire a measure of combatant power at sea equal in all respects to that of the British Empire. A claim to all-inclusive naval parity was put forward at the Washington Conference in 1921, and as at that time the United States were not regarded as amongst our potential enemies, any more than they are now, their claim to equality was readily conceded by the British Government. From that day to this, America's right to maintain a naval force not inferior in strength to that of the British Empire has been taken for granted. On political grounds it was infinitely better that the two nations should come to a friendly understanding on the question of relative naval power instead of engaging in a futile and costly shipbuilding race, which, by the way, our straitened finances were in no condition to sustain. We do not suppose that the most patriotic American would pretend that his country actually requires a navy "second to none." As a self-supporting Continent, possessing no overseas territories of major importance, and separated from all other Naval Powers by the breadth of oceans, she is of all great communities the least vulnerable to naval assault. To her therefore a great navy is of value chiefly as a symbol of prestige and world power. To us, on the other hand, it is an indispensable condition of national existence. For this reason our interest in every discussion on naval armaments must of necessity far transcend that of the United States.

Our delegates went to Geneva with a well-considered and detailed plan of naval limitation. It provided for a reduction in the tonnage standards of capital ships and cruisers which had been established at the Washington Conference, and at the same time it extended the 5–5–3 scale of relative strength to heavy cruisers, a class which had previously remained outside that formula. The great merit of the plan was that it would have enabled a substantial reduction to be effected in the cost of future naval construction without prejudice to the relative standing of any Power concerned. It would have led eventually to the disappearance of the needlessly large and expensive type of cruiser, displacing 10,000 tons, with an armament of 8in. guns, which had been fathered by the Washington Conference, and its substitution by a medium type of 7500 tons, mounting nothing heavier than 6in. guns. Furthermore, capital ships to be built under the Washington replacement programme would have been restricted to 30,000 tons and 13·5in. guns, and definite limits of tonnage and armament were also suggested for torpedo craft and submarines. From the very first, however, these proposals encountered bitter opposition from the American delegates. They laid stress on the special need of the American Navy for ships of the widest possible radius of action, owing to the absence of overseas bases, and further contended that the plan would unfairly advantage the British Empire, thanks to its incomparable chain of naval stations—which endowed even small cruisers with an unlimited range of mobility—and its fleet of ocean liners, which, armed with 6in. guns, would be capable of serving as cruisers in time of war. In our judgment, not one of these arguments will bear examination. So far as the most important sea routes are in question, the United States is much better off for naval bases than the British Empire, and therefore the demand for great steaming endurance is only to be explained on the assumption that American naval strategy envisages the conduct of warlike operations at a considerable distance from the Atlantic or the Pacific seaboard. As for Britain's "incomparable chain of naval bases," the great majority of them are undefended or lightly protected fuelling stations, our tenure of which might well become precarious in certain circumstances. The fact that we have no battleship dock anywhere in Eastern waters, where there are British interests of the first magnitude, sufficiently disproves our alleged superiority in naval bases. With regard to the possible conversion of liners into armed cruisers, the presumption that the largest liner could face a regular man-of-war has been rightly dismissed by Lord Jellicoe as "a landsman's notion." It is true that in the late war we did make use of such vessels for blockading duty, but at no time, not even at the acutest period of the cruiser shortage, were they ever regarded or employed as a substitute for the cruiser proper. In this connection there has been so much loose talk by American critics of Britain's "vast fleet of ocean greyhounds," which they insist upon classing as potential cruisers, that the facts deserve looking into. One of the most important attributes of the cruiser is speed. Of the vessels of this type now building and projected, the slowest is designed for 31½ knots, and the greater number are engined for 33 knots. Yet our fastest liner can only make 26 knots, and is thus at least 5 knots slower than the accepted minimum. We have two liners of 26 knots and two of 23–24 knots, all the rest being of considerably lower speed. So much for our "potential reserve of swift armed liners." The main dispute at Geneva has centred about cruisers. The requirements of the British Empire in this type, as stated by our delegates, call for seventy ships, of which, however, only a small proportion need be of the heavy 10,000-ton class. America regards this total as excessive, and complains that she would have to build a vast amount of new tonnage in order to achieve the equality on which she has set her heart.

She proposes therefore that the British Empire and the United States should each accept a maximum allotment of 400,000 tons of cruisers, each being left free to invest this allowance in big, medium or small ships, whichever it pleases. Under this arrangement America might, and probably would, build nothing but 10,000-ton cruisers, since she requires very few vessels for commerce protection, and is thinking mainly of battle power. We, on the other hand, require a very large number of cruisers for commerce protection, a duty that can be adequately performed by ships of 7500 tons, or even less. Consequently, the British delegation is urging limitation by numbers and individual types rather than by total tonnage. The former is unquestionably the fairest and most reasonable method, and we are frankly at a loss to understand why it should be opposed by the Americans. It was announced from Washington on Monday that America might be prepared to consider a cruiser limitation agreement on the basis of the 7500-ton class if Britain would agree to accept 8in. guns instead of 6in. as the maximum calibre for such ships. That is a concession which we think ought to be made. There is no particular reason why light cruisers should be restricted to 6in. guns—several foreign vessels of less than 7500 tons have been designed for an 8in. armament—and the acceptance of the heavier calibre would help to dissipate American fears regarding the possible use of our liners in wartime, since it is doubtful whether 8in. guns could be safely discharged from the decks of the largest liner. The position of Japan in these discussions is not altogether clear. It seems, however, that she is indisposed to accept 400,000 tons as the common cruiser quota for Britain and America, because under the 5-5-3 ratio that figure would increase her own allowance to 240,000 tons. She would therefore be compelled to build additional ships, a course which she holds, reasonably enough, to be inconsistent with the programme of naval limitation and retrenchment which she understood to be the aim of the present Conference.

The fate of the Conference is expected to be decided by next week's proceedings. It is significant that the consequences of a failure are being already widely canvassed. That it would result in a feverish shipbuilding race between the three Powers we do not for a moment believe. Great naval programmes are rarely undertaken solely from motives of *amour propre*, and it is just possible that the American people, when it came to the point, would jib at the prospect of spending vast sums of money on a fleet which bore no relation to actual defence requirements, and was plainly designed for no other purpose than to rival the British Navy. On the other hand, the naval propaganda which would inevitably rage in America might have political reactions of an undesirable character. It is to be hoped therefore that the delegates at Geneva will bend all their efforts to discovering common ground and not allow themselves to be unduly influenced by doctrinaire views of naval policy. Up to the present, so it seems to us, there has been too much concentration on technical *minutiæ*, to the exclusion of those broader principles which should dominate a great international gathering convened for the promotion of peace and goodwill among the nations.

The Theory of Boiler Furnace Design.

THOSE acquainted with Professor Wohlenberg's work on the theory of heat absorption in boiler furnaces will welcome as a further contribution to our knowledge the paper of which we print an abstract elsewhere in this issue. In collaboration with Mr. F. W. Brooks, he now draws certain important conclusions from the equations he had previously developed and gives guidance to the designer in a field where some direction was badly needed. Until the appearance of his first paper in 1925 there had been almost no scientific study, in the light of physical laws, of the heat reactions between the contents of a furnace and the surfaces by which they are surrounded. The question of heat transmission in boilers had been much too largely identified with problems of heat conduction in the parts beyond the furnace, and the emphasis laid by such authorities as the late Professors Perry and Nicolson on the teachings of Osborne Reynolds had caused the velocity of gases over the heating surfaces to be regarded as the fundamental factor in boiler design. The influence of radiation was generally neglected and the furnace came to be looked on merely as a place for burning coal efficiently, the idea being that the heat evolved should subsequently be transmitted to the water by the passage of the hot gases over the tubes or plates. The defect of this view was its neglect of the enormous possibilities of the furnace itself in transmitting heat directly by radiation to the water-cooled surfaces. With internally fired boilers of the locomotive, Lancashire or Scotch types, the radiation took care of itself even if the designer overlooked its effects. In the case of externally fired water-tube boilers, however, there was far more scope for good or bad furnace design. Restrictions on the shape and size of furnaces were largely removed, and, more important still, the existence of brick walls and arches introduced a factor tending to vary very greatly the conditions as regards the direct transmission of heat from the burning fuel to the boiler surfaces by radiation. As boilers increased in size, and particularly with the advent of powdered fuel firing, the problems of furnace design became more insistent. With furnaces 25ft. to 30ft. high the boiler surface that could be exposed to direct radiant heat became proportionally diminished, and the immense amount of brickwork subjected to this intense heat introduced new difficulties. Air-cooled furnace walls with the corollary of heated combustion air still further complicated matters, and finally the development of water walls came about, probably owing primarily to the idea of reducing brickwork troubles, but tending to restore the conditions for utilising radiant heat which made the internally fired boilers so efficient as steam raisers.

In this rapid development of furnace design practice had as usual run ahead of any consistent theory. With the Perry-Nicolson ideas relegated to the convection area of the boiler, to which they properly belong, the time had come for some guiding theory as to what happened in the furnace itself as regards the transmission of heat. The need for such a theory was indeed all the more felt because of the freedom which the designer had for doing pretty much as he liked. In the case of internally fired boilers practical considerations dictated the style and proportions of the furnaces, so that whether the theory of heat transmission in them was right or wrong, or even whether there was any theory at all, did not much matter. With external furnaces, however, the range of possible design was almost unlimited, and the guidance of theory was needed for choosing the best for any given conditions. The first serious attempt at such guidance was probably the paper presented by Professor Wohlenberg and Mr. D. G. Morrow before the A.S.M.E. in 1925. The paper was entitled "Radiation in the Pulverised Fuel Furnace," but the treatment of the subject was so fundamental that it bore upon the design of furnaces of every kind. All available physical knowledge concerning the radiation from gases, burning particles and surfaces was drawn on, and as a result of a mathematical analysis certain equations were arrived at. Of these perhaps the most important expressed the percentage of the energy liberated by the fuel which would be absorbed by the lowermost rank of tubes or other water-cooled part of the furnace envelope. The next year, in collaboration this time with Mr. E. L. Lindseth, Professor Wohlenberg further developed his theme in a paper on "The Influence of Radiation in Coal-fired Furnaces on Boiler Surface Requirements, and a Simplified Method for its Calculation." The simplification was brought about by taking as a standard furnace one surrounded entirely by water-cooled walls, and referring other furnaces to it. A factor was obtained giving the heat-absorbing capacity of a furnace with a given ratio of water-cooled surface, as a fraction of the heat-absorbing capacity of the totally cooled furnace. This factor was not directly proportional to the ratio of water-cooled surface to the total surface or to the "fraction cold," as the authors succinctly expressed this ratio. A furnace with only 50 per cent. of its surface water cooled might absorb nearly 90 per cent. as much heat as if the whole of the surface were cooled. Even with a "fraction cold" equal to only 10 per cent., the heat-absorbing capacity might be 50 per cent. of that of a completely cooled furnace. These results are not really surprising, for obviously the smaller the water-cooled surface, the greater is the area of white-hot brickwork radiating heat into it. Having got the matter down to a definite numerical or quantitative basis, the way was opened for further investigations. From what has been said about the decrease in the heat-absorbing capacity per square foot of water walls as the proportion of the furnace covered with these walls is increased, it is clear that there may be a certain "fraction cold" in the furnace which will be consistent with the minimum amount of heating surface for the whole boiler. In other words, after a certain proportion of the furnace has been provided with water tubes, it may be better to put any further heating surface required in the convection part of the boiler rather than in the furnace. This is an important question, which is answered in the affirmative for many of the conditions assumed by Professor Wohlenberg and Mr. Lindseth. The subject is further developed in the paper we print elsewhere. The conclusion is arrived at that water walling may be overdone if the object of the designer is merely to reduce his exit gases to a given temperature with the minimum total heating surface. It is, however, pointed out by the authors that as the effect of water walling is to reduce the furnace temperature, for a given temperature the presence of water walls permits of an increase in the quantity of fuel burnt, and therefore of the output of the boiler. Thus for the sake of obtaining a very high furnace rating it may be justifiable to construct most of the furnace with water walls, even though the total heating surface of the boiler is increased thereby.

Whether one accepts or not the actual figures arrived at by the authors, their work is valuable and suggestive in the highest degree. As an attempt to put furnace design on a rational basis it opens up the whole question of the principles of furnace construction. Instead of asking oneself how much water-cooled surface is advisable in a furnace, it is equally pertinent to ask how much brickwork is really necessary. Furnace brickwork, and especially when it takes the form of arching, is costly, troublesome, and comparatively short-lived. Brick-built furnaces undoubtedly came into use in order that the boiler construction might be kept simple. With furnaces only a few feet high the brickwork worked under easy conditions, and the adjacent tube surface helped to keep it cool by radiation. With large modern furnaces, preheated air and intense rates of combustion, it would seem that brick walls have nearly had their day. If a fire will burn in the small water-cooled brickless furnaces of Lancashire or Scotch boilers, it needs considerable audacity to maintain that combustion cannot be carried on at least equally well in a larger furnace completely surrounded by water walls, where the chilling effect is proportionally less and preheated air is available. That some of the leading engineers are coming to the opinion that brickwork is out of place in a furnace is shown by the design of the boilers for the new East River generating station of the New York Edison Company. These boilers, each of which has a maximum evaporation of 250,000 lb. of water per hour, have all four furnace sides made of Murray fin-tube walls, so that, with the boiler tubes at the top and the water screen at the bottom the burning fuel is completely surrounded by water-cooled surfaces. In these furnaces, which have a volume of 15,888 cubic feet above the water screen, no brickwork or refractory material at all is used. The same principle of enclosing the combustion space on all sides by water-cooled surfaces has been adopted in the new Wood boiler, and the day may not be far distant when brickwork in any large boiler furnace will be considered a troublesome anachronism. In any event this is the direction in which practice is moving, and we hope that engineers in this country will do their share in assisting progress both by emulating the bold experimental work reported from America and by studying the heat reactions in furnaces along the lines introduced by Professor Wohlenberg.

BOOKS RECEIVED.

Navigational Wireless. By S. H. Long. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 12s. 6d. net.

Modern Electrical Illumination. By C. Sylvester and T. E. Ritchie. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 42s. net.

A Manual of Rigging for Aircraft, 1927. Air Publication 1107. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. net.

Electrical Engineering Practice. Vol. II. Fourth edition. By J. W. Mears and R. E. Neale. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 25s. net.

Minutes of the Proceedings of the Institution of Civil Engineers. Vol. 222. Edited by H. H. Jeffcott. London: The Institution of Civil Engineers, Great George-street, S.W. 1.

Proceedings of the Institution of Heating and Ventilating Engineers (Incorporated). Vol. XXIV. 1925 to 1926. London: The Institution of Heating and Ventilating Engineers, 12, Russell-square, W.C. 1.

Report on the Irrigation, Water Supplies for Stock, Water, Law, etc., of the Colony and Protectorate of Kenya. By A. D. Lewis. London: The Crown Agents for the Colonies, 4, Millbank, S.W. 1. Price 5s. net.

POWER TRANSMISSION SCHEME IN SOUTH WALES

MESSRS. ARTHUR ELLIS AND PARTNERS, CARDIFF, CONSULTING ENGINEERS

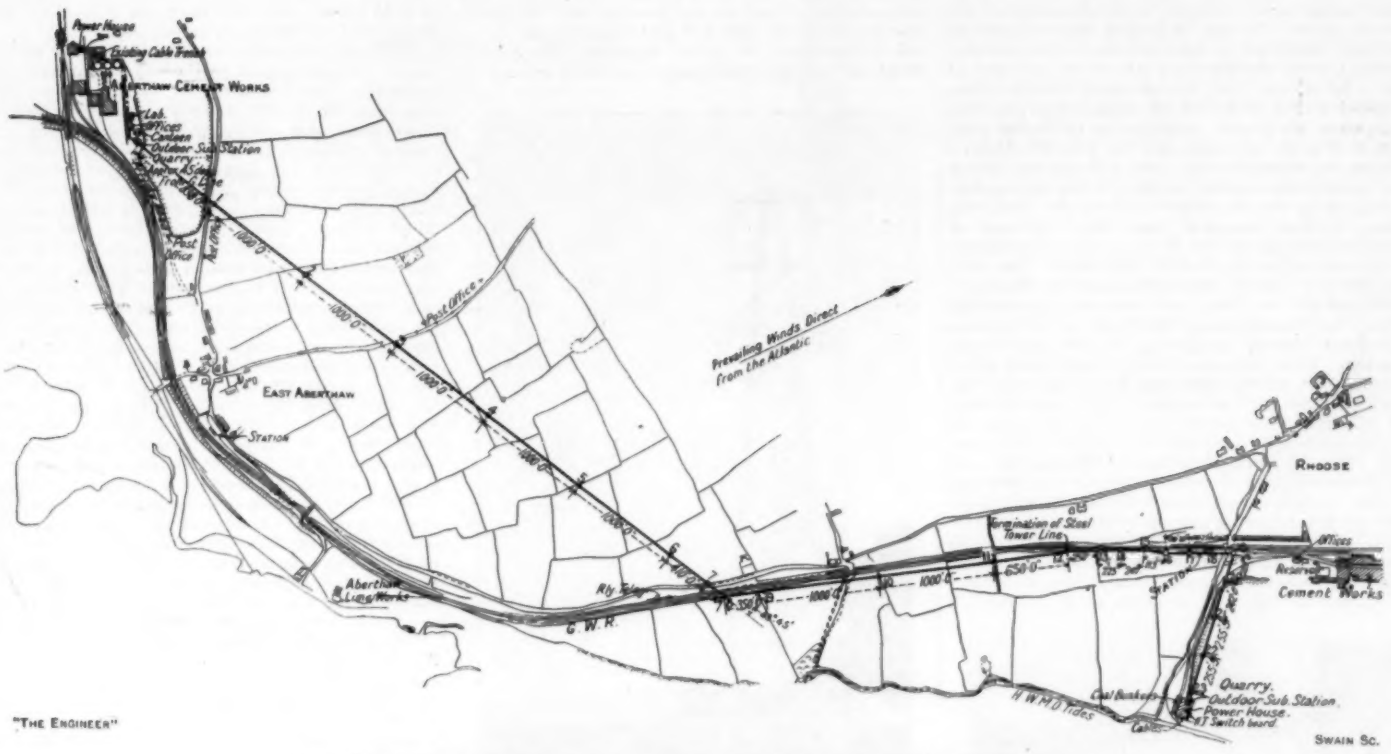


FIG. 1—ROUTE OF TRANSMISSION LINE BETWEEN ABERTHAW AND RHOOSE CEMENT WORKS

A South Wales Power Transmission Scheme.

THE works owned and operated by the Aberthaw and Bristol Channel Portland Cement Company, Ltd., are situated at Aberthaw and at Rhoose, on or close to the shore of the Bristol Channel, some 10 or 12 miles west of Cardiff and about 2½ miles apart.* These two works were at one time under different managements, and even after they both came under the control of the Aberthaw Company they continued to be separate organisations and, on the production side at least, to compete against each other. The chief factor in the competition resided in the cost of the power consumed at the two works. Some years ago the power station at the Rhoose works was modernised by the installation of two 2500 kW Brush-Ljungstrom turbo-alternators and a modern equipment of three Babcock and Wilcox water-tube boilers. The Aberthaw works, on the other hand, were driven by a power plant of an older and less efficient type, namely, by three 1500 kW turbo-alternators supplied with steam by five Lancashire and two water-tube boilers. The difference in the efficiency of the power plants was recognised as constituting a handicap on the Aberthaw works. To modernise the Aberthaw power-house on the lines followed at Rhoose would, no doubt, have solved the problem, but it would have been an expensive solution. It was therefore decided to investigate the possibility of solving it by interconnecting the two power-houses with the object of driving both the works from the Rhoose station, the plant at Aberthaw, if possible, to be shut down and maintained only as a standby. The investigation was entrusted to Messrs. Arthur Ellis and Partners, consulting engineers, Cardiff, who in February, 1926, submitted a report to the company giving their conclusions.

Although the distance over which the power was to be transmitted was short, approximately 2·4 miles, the scheme proved to be one of very great interest by reason of the fact that it presented in miniature many of the factors found in the large national schemes for linking up generating stations contemplated by the Electricity Commissioners. In addition, the transmission line as finally designed and erected embodies features which, it is claimed, are new to transmission line practice in this country. For these two reasons the particulars of the line which we gathered during a recent visit of inspection will, we think, be studied with interest beyond what the local importance of the line might appear to justify.

Before describing the construction of the line we will summarise the results of Messrs. Ellis's investigations. The data from which these results were derived were the records and charts for the two stations for the year 1925. At both stations, it may be remarked, the system of supply is the same, namely, by three-phase alternating current generated at 3300 volts with a frequency of 50 cycles per second.

As a considerable part of the higher cost of generating the Aberthaw supply is accounted for by the extra cost—5s. 6d. per ton—paid for the coal used at that station, it should be explained that the plant at Aberthaw could not be run satisfactorily on the poorer quality of fuel supplied to the more efficient plant at Rhoose. Had it been possible to utilise coal costing 17s. 6d. per ton at the Aberthaw station, the cost per unit generated at that station would have been reduced from 0·404d. to 0·333d.

It will be seen that the combined peak loads of the two stations amounted to 4900 kW, so that the total capacity of the plant at Rhoose would be just more than sufficient to run the two works. Actually the margin, it was found, would be more than that indicated by reason of the fact that the maximum peak loads at the two works did not coincide in time. The records showed that the maximum combined loads

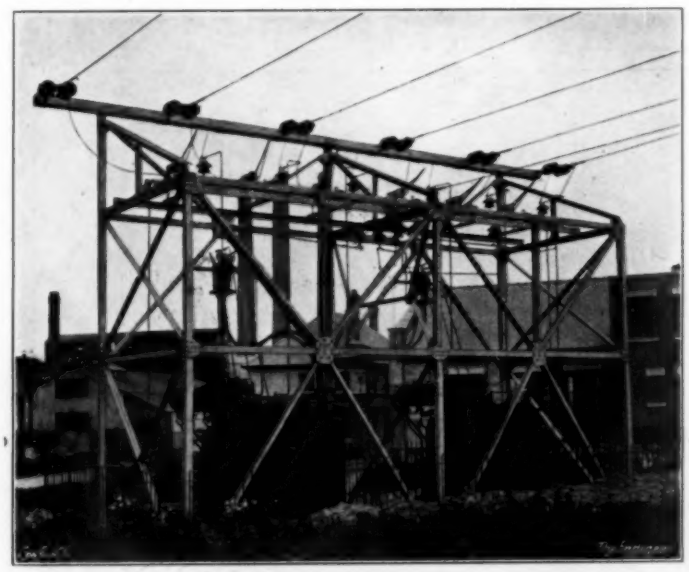


FIG. 2—OUTDOOR SUB-STATION AT ABERTHAW

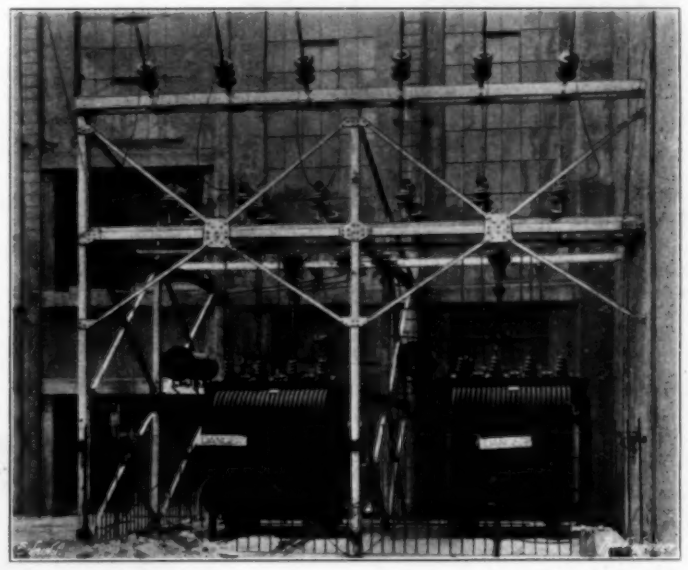


FIG. 3—OUTDOOR SUB-STATION AT RHOOSE

* A very full description of the Aberthaw works will be found in our issues of April 23rd, 1915, *et seq.*

never exceeded 4300 kW. The connecting up of the two stations would therefore reduce the actual capacity of the plant required to drive the two works. In addition, it would increase the load factor on the Rhoose plant from 25·27 to 69·3 per cent., and consequently might be expected to result in an improvement in the already high efficiency of the Rhoose plant. It was estimated that under the improved conditions of load and load factor the fuel consumption at the Rhoose works would be reduced from 1·96 lb. per unit to at least 1·75 lb. The combined output of 30,373,700 units would therefore be obtained for a coal consumption of 23,729 tons, which at 17s. 6d. per ton would cost £20,762. Making a liberal allowance for the increased cost for labour, maintenance and repairs at the Rhoose works consequent upon the increased load thrown upon the station, it was estimated that the total cost of generating all the power at that station would be £28,262, equivalent to 0·223d. per unit.* In 1925, with the two stations working separately, the combined cost for the same total output was £45,782, so that by concentrating the load on the Rhoose station an annual saving of £17,519 was to be expected. From this sum there would have to be deducted the costs incidental to maintaining the Aberthaw station as a standby with a nucleus staff and the charges for interest and amortisation on the capital involved in providing the transmission equipment. The consulting engineers estimated the cost of the transmission system at between £17,000 and £18,000. Taking interest and amortisation at 12½ per cent. on the larger figure, they estimated the net actual saving by concentrating the load on the Rhoose station at £15,269 per year. The actual cost of the complete transmission system has, we understand, come out at approximately £16,750, and it is

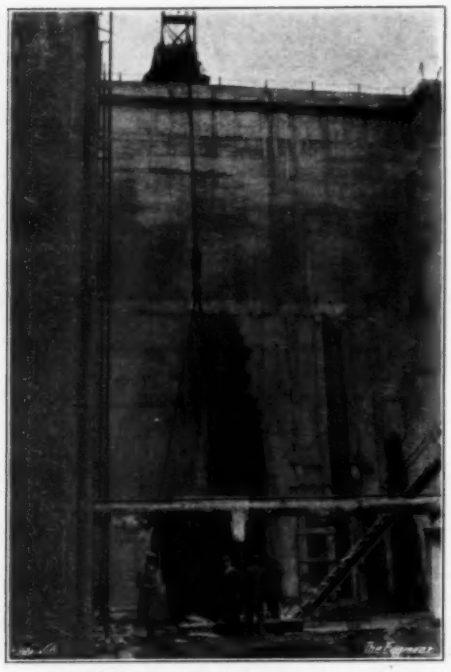


FIG. 4—LOWERING TRANSFORMER INTO POSITION AT RHOOSE

confidently expected that the whole of that sum will, as the result of the savings effected, be entirely disposed of within a period of less than two years from the start of the combined operation of the two stations.

The facts revealed by the investigations of the consulting engineers can best be set forth in tabular form.

	Aberthaw.	Rhoose.
Turbo-alternators	3 at 1500 kW = 4500 kW	2 at 2500 kW = 5000 kW
Boilers	5 Lancs.+2 W.T.	3 W.T.
Total evaporation	59,000 lb./hr.	66–90,000 lb./hr.
Staff, operation and maintenance	23 men	14 men
Staff, wages per annum ..	£5,089	£3,000
Repairs and maintenance costs per annum	£3,000	£1,139
Units generated	19,303,600	11,070,100
Fuel, tons	20,683	9,704
Fuel, price per ton	23s.	17s. 6d.
Fuel, cost	£23,804	£8,523
Other charges	£8,699	£4,756
Total cost	£32,503	£13,279
Cost per unit	0·404d.	0·287d.
Fuel per unit	2·4 lb.	1·96 lb.
Peak load, maximum ..	2800 kW	2100 kW
Plant available for load ..	3000 kW	2500 kW
Standby plant	1500 kW	2500 kW
Load factor on total plant	49 per cent.	25·27 per cent.
Load factor on plant available	73·5 per cent.	50·54 per cent.

* A minor advantage of the interconnection scheme was revealed during the detailed examination of the records. It was found that on Sundays the actual combined loads on the two stations was less than 2500 kW, and therefore could, after the connection had been made, be carried by one of the units at the Rhoose station. The existing conditions required one of the Rhoose units to be run under a very light load, while at Aberthaw the Sunday load was somewhat in excess of 1500 kW and required the use of two of the units. In effect, therefore, the Sunday conditions required the operation of three units of an aggregate capacity of 5500 kW for a load of less than 2500 kW.

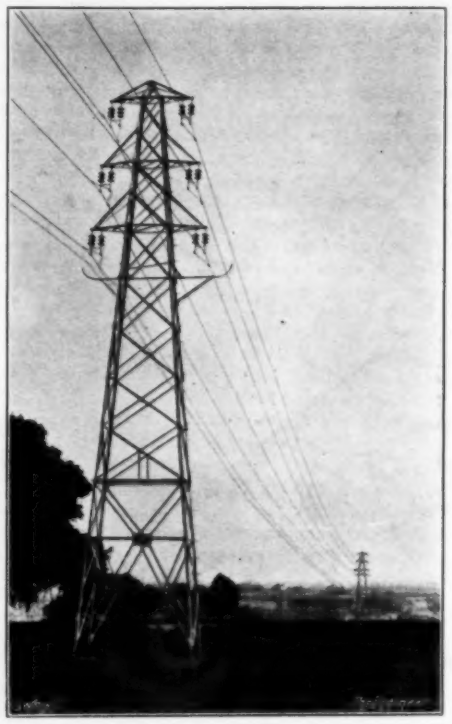


FIG. 5—NORMAL 1000-FOOT SPAN

The consulting engineers, as a result of their investigations, recommended that the two stations should be linked up at the earliest possible date. They suggested that the transmission system should be made suitable to deal, not only with the complete interchange of the existing load, but also of the load which future extensions to the two works might throw upon it. They indicated an overhead system of transmission as suitable to the needs of the situation and suggested that the line should be on the double-circuit principle, and that it should be equipped with outdoor transformers.

The contract for the erection of the transmission system was awarded to the Foundation Company, Ltd., of London, sub-contracts for the supply of the four outdoor transformers, each of 1875 kVA capacity, being arranged with Ferranti, Ltd., of Manchester, and for the switchgear at each end of the line with Erskine, Heap and Co., Ltd., of Manchester.

For transmission purposes the 3300-volt alternating current generated at either station is transformed to a pressure of 33,000 volts before being passed into the line, and at the other end is stepped down to its original voltage. The conductors employed consist of steel-cored aluminium cables, each comprising seven strands of 0·102in. galvanised steel wire surrounded by two layers containing together thirty strands of 0·102in. aluminium wire. These conductors have each a conductivity equivalent to 0·15 square inch of copper and a breaking stress in excess of 50,400 lb. per square inch.

The route followed by the line is shown in the map, Fig. 1. In the course of its length it crosses three roadways, two footpaths, a railway, the quarry adjoining the Aberthaw works, two post office telephone lines, and one telephone line belonging to the railway company. The spacing of the steel towers carrying the line is based on 1000ft. as the standard distance apart, modifications of this dimension being made where circumstances made it advantageous to adopt a lesser span. Starting from the Aberthaw sub-station, a span of 838ft. brings the line to the first tower on the far side of the quarry, a roadway, and a post office telephone line. Five 1060ft. spans in a straight course carry the line to the sixth tower, the route being across fields and at one point, close to the third tower, across a second roadway and a second post office telephone line. Towers 7 and 8 continue the line in its straight course for a further 610ft. The 200ft. span between these two towers carries the line across a roadway, a railway, and a railway telephone line. At tower 8 the line bends through an angle of about 45 deg. and is carried on to tower 9 by a span of 350ft. The three spans between towers 6 and 9 total 960ft. and may be regarded as a normal 1000ft. span, the profile of the cables between towers 6 and 9 taking the form of one parabola and not three. The result of this arrangement is that towers 7 and 8 are situated at approximately the lowest portion of the parabola. As a consequence the heights of these two towers are considerably reduced below the normal —70ft.—and the bending moment on the angle tower No. 8 is proportionately lessened. Two normal spans of 1000ft. and a short span of 650ft. carry the line, parallel with the railway, to the twelfth tower. This tower may be regarded as being near the lowest point of a normal 1000ft. span and is proportionately reduced in height. It is in the nature of a terminal tower, for at this point restrictions of the site made it impossible to continue the use of steel towers. At points 13 to 18 the line is supported on wooden poles erected on the railway company's ground and designed and placed in such a way that no part of the transmission system projects over the adjoining fields. At point 19 there is a low steel angle tower and from it the line is carried in a straight course on wooden poles down to the sub-station at Rhoose. The route followed from the angle tower No. 8 to the Rhoose sub-station is not the ideal one, but it was rendered necessary by reason of certain wayleave difficulties.

The Aberthaw sub-station—see Fig. 2—comprises a self-supporting steel structure which has also been made to serve as an anchorage for the six cable ends. From the transformers underground copper cables connect the overhead system with the Aberthaw power-house. At Rhoose the sub-station—see Fig. 3—is also a steel structure taking the anchorage stresses, but it is not entirely self-supporting. It is situated in a re-entrant angle of the power-house building and derives support from the walls. The open position of the Aberthaw sub-station presented no difficulties in the way of getting the transformers into position, but at Rhoose the circumstances were otherwise. The Rhoose power-house, for reasons connected with the supply of sea water to the condensers, is sunk well below the level of the surrounding land. At one point—see Fig. 4—the side of the excavation is buttressed by a concrete retaining wall. The railway siding serving the works runs along the

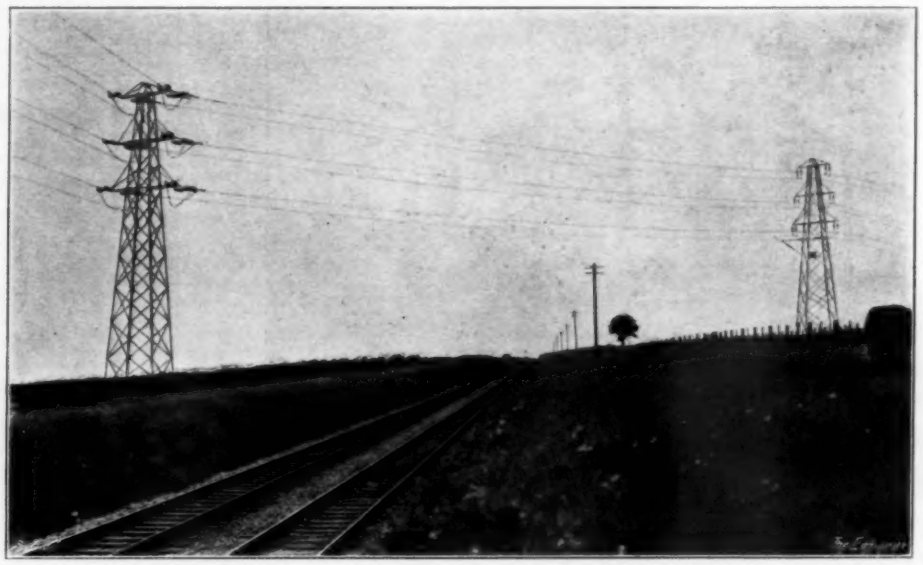


FIG. 6—RAILWAY AND ROAD CROSSING

* Since this article was written the line has been put into operation. We are informed by the consulting engineers that the figure realised during the first few weeks' operation has been 0·212d. per unit generated at the Rhoose Station.

TRANSMISSION SCHEME IN SOUTH WALES

THE FOUNDATION COMPANY, LTD., LONDON, CONTRACTORS

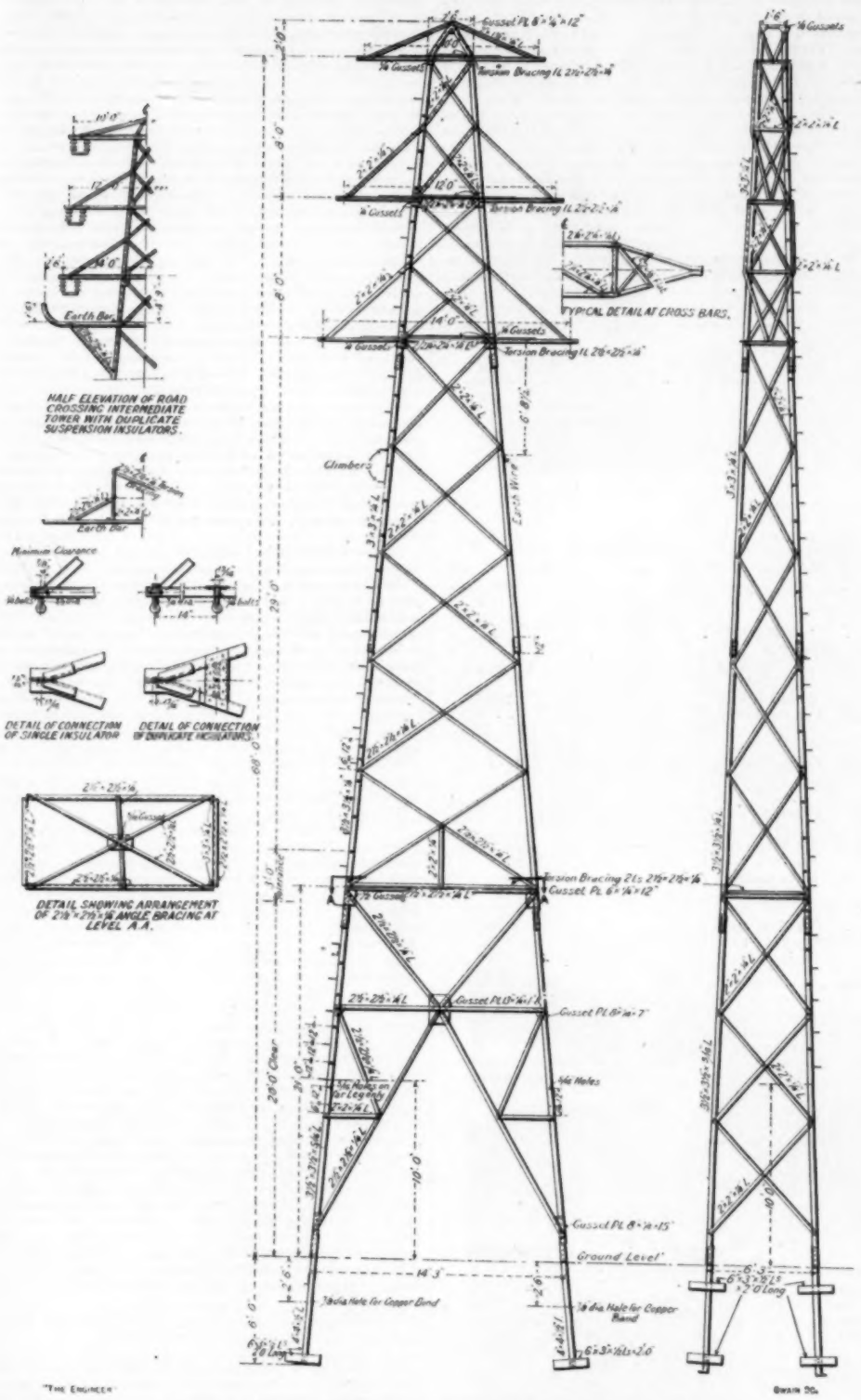


FIG. 7—GENERAL ARRANGEMENT OF INTERMEDIATE SUPPORTING TOWER

top of this wall. At the foot of the wall there is a deep pit flooded with water, into which the ashes from the station boilers are discharged, the pit being periodically emptied by means of grabs lowered from the siding overhead. This unpromising position involving the lowering of the 14-ton transformers a distance of 64ft. on to baulks of timber fixed across the ashpit, and their subsequent dragging into their final place, was successfully surmounted without mishap with the aid of a standard G.W.R. travelling crane in charge of an experienced railway official.

In Fig. 5 we illustrate a normal 1000ft. span, the tower in the foreground being No. 3 and that in the distance No. 2. Just beyond the hedge is a roadway, along which a telephone line runs. It was found more economical to relay—with the permission of the Post Office—a short length of the telephone line below ground than to allow it to remain in the air and to protect it by the usual system of bridling. The same expedient was resorted to near tower No. 1. In Fig. 6 we illustrate the railway and road crossing with tower 7 on the right and the angle tower No. 8 on the left. The railway telephone line has been allowed to remain in the air, but to protect it as well as the road and the railway each cable in the 200ft. span has been duplicated and each pair lashed together, with a corresponding reduction in the stress. The duplicate cables are supported by duplicate insulators.

The general arrangement of the intermediate supporting towers is illustrated in Fig. 7. The structure is composed of galvanised steel angle irons and gusset plates, all the joints being made by means of bolts. The novelty in the design of the towers so far, at any rate, as this country is concerned lies in the fact that they are designed with light scantlings so as to be semi-flexible in contrast with the rigid structures commonly adopted for similar work. As ordinarily constructed, towers of this kind are required to possess a sufficient reserve of strength to accommodate, without flexure, the stress that would be thrown upon them if one or more of the transmission cables broke. In the present instance the towers are designed to deflect under a broken wire load. If one or more of the cables break, the unbalanced pulls of the remaining cables on the cross arms at the top of the tower will cause the tower to twist. The design is such that when the position of equilibrium is reached the stress in every member of the structure and in each of the intact cables shall be below the elastic limit. As compared with a rigid structure, the design shows a considerable saving of weight. This saving is the principal reason for adopting the semi-flexible design.

In accordance with the requirements of the Electricity Commissioners, the towers at spans crossing roadways are provided with an earth bar just below the lowest cross arm, the intended object of which is to make contact with a falling wire and to earth it before or immediately after it reaches the ground. It will be observed that to impart semi-flexibility to the structure there is no torsion bracing from a point 21ft. above the ground up to the lowest of the cross arms.

The stubs of the tower legs were set 6ft. into the ground, approximately 8 cubic yards of concrete being used per tower. On these stubs the tower structure was erected *in situ*, member by member. It is common practice in work of this description to assemble the towers horizontally on the ground and then raise them into position as completed structures. In this case the size of the contract and the number of towers involved did not justify the expense that would have been entailed in providing the gear required to raise the towers. A minor feature of the design to which attention may be paid is the fact that the width and clear height at the base are sufficient in one direction to enable a plough to pass between the legs. The presence of the tower in a field does not, therefore, hamper ploughing operations or reduce measurably the area cultivatable. This consideration is often an important factor to farmers when they are asked to grant wayleaves.

A continuous earth wire consisting of seven strands of No. 8 S.W.G. galvanised wire runs the full length

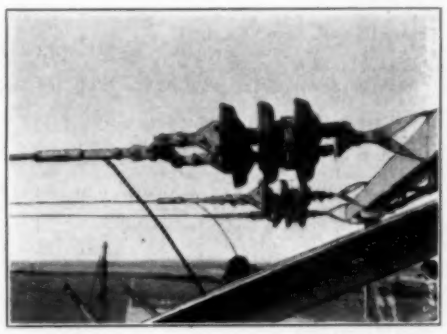


FIG. 8—TENSION INSULATORS AND TERMINAL CLAMP

of the line. This wire is connected to each tower by a tinned copper conductor which, in turn, is connected to a cast iron earth plate buried in coke at the foot of the tower.

The insulators supporting the conductors are of Messrs. Buller's suspension type. At the road and rail crossing, where the conductors are in duplicate, the insulators are arranged in pairs at the ends of the cross arms. Duplicate insulators are also used on towers 2 and 3 in order to accommodate the cables and auxiliary safety bridle wires which are lashed to them over the roadways. Elsewhere single insulators are used. The insulators under tension—that is to say, those at the sub-stations, at the angle tower No. 8, at the terminal tower No. 12, and at the angle tower No. 19—are also of Messrs. Buller's manufacture. In Fig. 8 we illustrate the design of the tension insulators at the sub-stations. This engraving also shows the terminal clamp for the aluminium steel conductor and the copper tail whereby connection to the switchgear is made. The design of the terminal clamp is such that the copper does not come into contact with the aluminium, a condition that might give rise to electrolytic action. The terminal stress is taken on a steel fitting and the copper lead is free from any mechanical load.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

HIGH-PRESSURE RECIPROCATING ENGINES.

SIR,—On page 656, June 10th, 1927, was printed a letter from "M.I. Mech. E." asking where accounts may be found of high-pressure piston engines in successful regular work.

In a list appended are mentioned several examples in point, although they are mainly from abroad. But large numbers of full-page advertisements in your journal prove that British makers produce compound engines with moderate pressures little inferior to recent German advances claimed to equal the Diesel motor in thermal efficiency. *De Ingenieur*, of the Hague, published, August 9th, 1924, detail drawings of the double-compound engines of ss. Bilbao consuming 2186 heat units per unit of work—calories per h.p.h.—against the best Diesel record of 2000. The steam consumptions of these double compounds were 6·5 lb. per I.H.P.-hour and 5·65 lb. per I.H.P.-hour, for 220 lb. and 446 lb. pressures respectively. This high economy appears to proceed mainly from a large ratio of cylinder volumes H.P. : L.P. Indicator cards are also given, showing, however, no superiority to those currently taken from compound locomotives when working with balanced piston loads. Under the heading "Motor Ship or Steamship," the *Hanomag Nachrichten* published, November, 1925, Seite 178, Heft 145, the logs of

ss. Bilbao, double-compound, average pressure 105 lb. (13 kilos.), with average costs in fuel for motor vessels at 2·1 marks and for compound steam engines (Bilbao) 1 mark per unit of work per hour.

The steam consumption rates here mentioned appear to be little above those recorded by the late Wilhelm Schmidt in his extremely fine tests of very high-pressure triple-expansion engines, published a few years back in the *V.D.I.*

It is admitted by *Power* (New York) that the piston engine, if brought up to date, is going to be a close competitor with the turbine. Some years ago the Manchester Association of Engineers allowed that, up to 3000 H.P., the piston engine was superior or equal to turbines. Your own most recently published figures prove the fact that even at very large powers the high-pressure turbine is not always the most economical. In an article on the new triple-expansion engines installed by Hathorn and Davey at Walton-on-Thames, you mentioned—August 13th, 1926—that in spite of the higher cost of the piston engine, its greater economy and durability outweighed preferences for the turbine.

For extremely high pressures, the reintroduction of piston engines for the high and intermediate pressures but with turbines for the low pressures, is now spoken of as a means to avoid certain eroding inconveniences experienced with extremely high steam velocities combined with very high steam temperatures. This combination has been made by Henschels for a moderate pressure locomotive with a view to take 50 per cent. more work out of the steam than is now done by single-expansion piston locomotives. From 50 to 60 per cent. greater power per pound weight of steam is almost invariably obtained where the steam is subjected to a second expansion in ordinary piston locomotives; but it is hoped to equal this result by means of low-pressure turbines in place of low-pressure cylinders.

An Australian newspaper recently reported that two important British steamship companies were fitting piston engines to all new tonnage. A marine engineer in this country named to me one of these companies, but as, personally, I have no means of confirming these statements, it would be interesting if some well-informed reader would do so. The argument is that in tropical regions the condenser water is of very high temperature and that piston engines then operate more economically on a low vacuum than turbines are able to do. It appears to be this same trouble of inefficient condensation of the exhaust steam which has rendered abortive the numerous attempts made during the past thirty years to employ turbines—already less efficient than piston engines—on railway locomotives. The prospects, according to *Power*, are now good for steam, and especially so for the piston engines, on which no real improvement has been made since the days of Loftus Perkins until the last year or two—Maurice Demoulin in his articles in this journal puts the no-advance period as thirty years. We have, indeed, to go back about fifty years to find records of very high thermal efficiency in steam engines equal, for a given quality of steam, to the efficiency as merely estimated as being possible by means of the reintroduction of high steam pressures.

"The so-called development of high pressures is merely a march back to the peak reached by Perkins a century ago," says the *Wheeler News*, of Carteret, New Jersey, in one of the best treatises on the works of three generations of Perkins yet published, in its issue of December, 1926.

For very precise information on the operation of very high steam pressures in engines—which were never lubricated, and possessed in this respect all the advantages of turbines—interested persons should refer to the paper read at the Royal United Service Institution, March 26th, 1877—just half a century ago—by Mr. Loftus Perkins, with Rear-Admiral Jasper H. Selwyn in the chair. The illustrations show the Perkins standard type of two-crank, two-cylinder, triple-expansion engine. The appendix gives 1 lb. coal per I.H.P.-hour for saturated steam marine engines of the Perkins system, as against 2¼ lb. for "present engines" at 60 lb. pressure. The drawings of boilers show the Perkins tubular boilers with only one large collector tube—which would now be termed a "drum"—and to which steam collector or very small "drum," present practice is now returning for the pressures at which the Perkins boilers were steam tested for hours, namely, 2500 lb. per square inch. Every Perkins tube was water tested separately to 4000 lb. per square inch. In this year's catalogues of Stewart and Lloyd, the Perkins tubes and patent union screw coupling are illustrated, and the pressure there stated is 4000 lb. About eighty years ago an insurance company, frankly inimical to the Perkins boilers, deliberately blew up one of them—not made by Perkins—at a pressure then estimated at 10,000 lb. per square inch, the result being a rift about 2in. long by ¼in. wide in one of the lowest tubes of the boiler. Loftus Perkins gives the bursting pressure of his boilers at 20,000 lb. per square inch. So far back as 1824 Jacob Perkins worked with cylinder pressures up to 1400 lb. per square inch.

As showing the remarkable fluidity of saturated steam at high pressures, and the absence of condensation which would otherwise obstruct its passage in a steam pipe of ¼in. bore, supplying, not a mere toy engine, but actually passing 100 H.P to a 50 H.P. nominal engine, Loftus Perkins mentions—page 8 of the reprint of the United Service "Proceedings"—the total absence of any priming in this ¼in. bore main steam pipe—unjacketed, as still shown by existing photographs. That pipe was afterwards taken off and cut into pieces. One piece used to hang on the watch-chain worn by Loftus Perkins, and it is remembered to-day by Sir J. Thornycroft; one is preserved in a museum at Peterborough ("Westwood") Works; another is owned by Mr. Loftus Perkins; and one gold-plated portion was "burgled" in the house of Mr. Taylerson, of Betchworth. Present-day conceptions of saturated steam are much opposed to the actual working experiences on a large scale by the three Perkins. Extremely high superheating was first due to Jacob Perkins (1827); but all three Perkins found it was not necessary or desirable.

At present, the great-grandson of Jacob Perkins—Ludlow Perkins—inherits the rights, and uses them, appertaining to the inventions of his three generations of ancestors as regards double-pressure boilers—to-day accepted as a new German invention—the hermetically sealed steam heating tube for power steam boilers, the evaporators and the condensers of Loftus Perkins, and a quantity of devices, such as unburstable, glassless water gauges for the highest of pressures, numerous mechanical inventions evolved during fifty years to overcome working difficulties encountered with extremely high pressures, &c. At the present moment, the most potentially valuable of these inventions certainly is the Perkins engine, compound and triple expansion, having practically only two cylinders and two cranks, with Perkins high-pressure tubular boiler and Perkins air or chemically cooled condensing apparatus, as adapted to locomotives (requiring only a small daily quantity of distilled water for make-up) for service on such lines as the trans-Australian Railway, where the absence of water for great distances is now described officially as a most serious problem owing to the rapid destruction of the boilers of the present superheated steam locomotives through the minerals in the transported water as used on the greatest part of that trans-Australian line. No Diesel motors and no turbines—both very complicated—offer such valuable advantages to the Australian Commonwealth as do the Perkins "no-oil" compound condensing locomotives. The compound locomotives by Perkins are, without question, far in advance of any of the recent new German compound locomotives, and were actually designed before Anatole Mallet first designed his own in the year 1875. The compound locomotive is therefore a British invention.

The following table shows the advances made, to date, by means of very high-pressure steam comparatively with low pressures and provides several references of value to those interested in steam as a motive power.

It appears as a fact, already pointed out in American journals, undeniable and undenied by anyone of competence, that thirty years ago with low-pressure saturated steam and with but one-half the complication of present machines, the locomotives then had a higher thermal efficiency, by the results as published at the time, than the very best of all modern high-pressure road results that have been published by any journal of the world at the present day. From this fact there is no possible escape, it seems.

This retrogression in locomotive practice is fully explained by the pressure indicator and the planimeter. With any given quality and pressure of steam these instruments invariably show from 50 to 60 per cent. larger diagram areas and horse-powers in double expansion than in single expansion for any given cut-off, speed and water consumption, equally in locomotives as in marine or stationary engines; and the comparative result is the same with compressed air and with any gas that does not condense, so that none of the economy can be credited to "avoided condensations" by expanding the steam in different cylinders. This ancient theory, attributed to Dr. Robison in the lawsuit Watt *v.* Hornblower, is refuted by every indicator card and by numberless tests of steam, of compressed air, and of gas; and although it is commonly printed in all text-books and in numbers of current articles, it is one of those great theoretical blunders which might well have appeared among "Howlers." page 656.

The "*Mechanical World* Engineers' Pocket Book" gives cylinder condensations, in percentages of feed-water consumption, as 22 per cent. in single-expansion engines and 18 per cent. in compounds, or 4 per cent. difference, at a mean cut-off of 30 per cent.; at 50 per cent. cut-off it is shown as 2 per cent. difference; but actual tests of locomotives, all using superheated steam, prove that no such steam saving is effected by "reduced condensation", in compounds which, nevertheless, average 54 per cent. more draw bar work per unit of coal than the most economical simple superheater locomotive of which there is record, *i.e.*, 19 lb. steam per I.H.P.-hour.

Progress has undoubtedly been hindered for years by the very strong opposition to the publication of indicator cards which prove the invariably greater power by 50 per cent. and per unit of steam consumption due exclusively to the second expansion of the working fluid—steam, air or gas—and whether the boiler pressure is 600 lb. or only 5 lb., and which is therefore equivalent to raising the horse-power of a boiler from 2000 H.P. to over 3000 H.P., in locomotives or in stationary engines.

In the first marine compound engines made in France, by Benjamin Normand, the power was immediately increased over "simples" by 50 per cent. per unit of coal consumed. In the first compound locomotives, tested fifty years ago on the Paris–Orleans Railway, the ton-mileage per ton of coal was augmented by 53 per cent. through the second expansion; and about that time the thirty years' vogue of superheated steam on railways ended completely when the second expansion was found to save still more coal than superheated steam, and, above all, to save costs in reduced repairs through its more uniform torque on the crank shaft or axle.

July 15th. CHARLES R. KING.

Recapitulation of Published Results of Steam Engine Tests.

	Reference.	Engines. Steam in pounds per I.H.P. hour. Turbine.	Piston.
Langerbrugge power station, turbines 667 lb. to 710 lb. pressure	THE ENGINEER, May 20th, 1927, p. 550, Table II.	7·7 to 9·13	—
Schiffbautechnische Gesellschaft, Berlin meeting, high pressures; estimated good examples	*Ibid.*, Dec. 10th, 1926, p. 641	12·76	9·46
Hamburg-Portuguese Line, ss. Bilbao, double-compound 900 H.P., per *Ingenieur* (Hague), August 9th, 1924	*Ibid.*, April 24th, 1925, p. 468	—	Pressures: 220, 6·5; 446, 5·65
Wolff "overtype" compound locomobiles up to 200 H.P., all makers; per numerous records during twenty years	—	—	7·5 to 8
Compound engine consumption, 258 H.P., with 114 lb. pressure	"*Mechanical World* P.B., 1917"	—	8·68
Compound vertical engine in Belfast, horse-powers 145 to 481, 120 lb. pressure (consumptions nearly equal for all loads)	Cole, Marchent and Morley	—	8·7 to 8·9
Simple uniflow, best result	Sulzers (1916)	—	10
London Electric Railways, per circular reprinted in Notes, 2 lb. coal per kW-hour = 16 lb. steam at 8 : 1 evaporation, converted to I.H.P.	THE ENGINEER, 1918	12	—
Non-condensing Locomotives (Piston)—			
Compound S. 11², Prussian State, Berlin–Hannover level lines, 17·6 lb. steam av. at draw bar = 12·3 lb. per I.H.P.-hour ("The most esteemed locomotives now working in Belgium," *vide Locomotive Magazine*)	THE ENGINEER, May 31st, 1912, p. 577 *Rivista Tecnica*, Vol. I., An. I., 1913	—	12·3
Compounds, "Pacific" 600-ton loads, entirely up-gradient at high speed, average of eight runs	THE ENGINEER, June 8th, 1917	—	13·5
New model de Glehn compounds, Brussels–Ostend, with unequal piston loads	*Revue Generale*	—	13·8 14·5
Ploughing Engines—			
Fowler compounds, 275 lb. pressure	THE ENGINEER, May 27th, 1927, p. 582	—	14·23

Recapitulation of Published Results of Steam Engine Tests.

	References.	Non-condensing piston engines. Per I.H.P. hour, gross water.	
Compound Engines, thirty years ago—			
With saturated steam at 160 lb. pressure in two-cylinder, very simple, compounds in regular road service, Austrian State (still on international expresses)	THE ENGINEER, October 30th, 1896 p. 438	—	19
Saturated steam at 165 lb. pressure in fast, stopping, services, Russian S.W.R., Kasatine–Kieff	"Proc.," Inst. C.E., France Mems., Oct., 1892	—	18·7
Saturated steam, 225 lb. pressure in passenger, stopping, trains, Roumanian State level lines, Bucarest–Ploesti	Official documents	At draw bar: 22·7	18·4
Simple-expansion Modern Engines—			
Best (published) results in Britain of the "Castle" class, G.W.R., Swindon–Plymouth–Swindon, mainly level line, 225 lb. pressure, extra-long valve travel (per Mr. Collett), superheated steam, net, deducting losses	THE ENGINEER, June 12th–19th, 1925	—	20·9
Maximum efficiency, American locomotives, 250 lb. pressure, superheat, feed heating, "limited maximum cut-off," long valve travel, low speed, freight, road test	*Rail. Mech. Eng.* (N.Y.), and THE ENGINEER, June 10th, 1927		18·6* 21·42† 21·55* 24·91†

* Deducting all losses. † Actual.

SIR,—In a letter which appeared in your issue of June 17th a correspondent states that he would be glad to know what is the highest steam pressure and steam temperature which is being successfully used under present-day conditions of continuous operation in a reciprocating engine of any size, say, not less than 100 H.P., and where a description of such engine can be found.

We have pleasure in informing you that such an engine in tandem arrangement for 850 lb. per square inch pressure was built in 1920 and tested by Professor Franke—Hannover—and can be seen working at the plant of our associate company—Schmidt'sche Heissdampf Gesellschaft, m.b.H., at Wernigerode.

Another one of the same type was built in 1924–1925 having the same boiler pressure, and was tested by Professor Josse—Charlottenburg—in the Borsig plant at Tegel near Berlin.

The description and the publication of the test results of the first engine can be found in the *Zeitschrift des Vereins Deutscher Ingenieure*, 1921, and that of the second engine in the same publication, 1926.

Two further engines of the same type for a boiler pressure of 685 lb. per square inch have been built, and will be at work in the autumn of this year in the plant of the Patzenhofer-Schultheiss Brewery at Berlin.

If your correspondent desires further particulars we should be glad to furnish them.

THE SUPERHEATER COMPANY, LTD.,
HARRY A. STENNING,
Managing Director.

London, July 21st.

BRITISH TRADE WITH FINLAND.

SIR,—A report by Mr. Cecil H. Mackie, British Consul at Helsingfors, is, I observe, being quoted in the Scandinavian Press. Mr. Mackie points out what has been perfectly plain

for some time, that the development of trade, particularly in such things as steel centres like Sheffield produce, has been very slow indeed—so slow, in fact, that while Finland's exports to this country last year were in the neighbourhood of £25,000,000, Finnish imports from the United Kingdom amounted to little more than one-fifth of that sum.

On the face of it, therefore, there would seem justification for the opinions being expressed in business circles in Helsingfors that British manufacturers are not taking advantage of the most-favoured nation treatment accorded to Great Britain under the Anglo-Finnish Commercial Treaty of 1924.

Mr. Mackie himself views with misgivings the placing with British rivals of important contracts for machinery and plant for the principal Finnish industries, for rails, locomotive and wagon wheel sets, tires, axles, springs, and other accessories for the Finnish State Railways, and for machinery and various other requirements for water-power installation.

The immediate answer, I know, is that the severe competition from the nearer markets of Sweden and Germany for the class of goods called for by Finland makes it extremely difficult for our manufacturers to bid for business which might show but a very narrow margin of profit.

Finland, however, in her new national character, is rapidly advancing commercially, and a little missionary work on the spot by representatives of British steel and machinery manufacturers should soon reverse the present state of things and go far toward adjusting to a more satisfactory level the balance of trade with this country.

One of the outstanding features of the timber trade is the extraordinary speed with which Finnish exports of sawn wood are bounding upward, having already exceeded those of Sweden by 100,000 standards or so per annum. Some of the best-equipped saw mills in the world are in operation there, which means a steadily rising demand for saw mill machinery and tools, wood waste utilisation machinery, power plants, transport equipment, and so on.

Our manufacturers may, of course, be in possession of information proving the futility of any special effort to obtain a better footing for British productions in the Finnish market, but the fact remains that Finland is very favourably disposed to England—her best customer for timber—and, goods and prices equal, would prefer to trade with us. The one thing needful at the moment seems for British manufacturers to send competent representatives to the country, thus establishing personal touch instead of relying on non-British agents. In this way the actual needs of the market could be studied, with a fair chance of successfully supplying them.

T. MORTIMORE SPARKS,
Editor, *Timber Trades Journal*.

London, July 21st.

THE SIEMENS-BENSON CRITICAL PRESSURE BOILER.

SIR,—As a confirmed believer in the utility of super-pressures, and in their eventual general adoption, I read with no little interest the article on the above subject which appeared in your issue dated June 24th, pages 690–691.

According to the illustrations, the principle employed in this boiler is to all intents and purposes the same as that of the old Serpollet system, which, in turn, was a variation of the Jacob Perkins' high-pressure generator of 1822. The latter, it will be remembered, was kept full of highly heated water by means of a pump, and a small quantity of the water was discharged at intervals into a tube, wherein it was immediately flashed into steam, the steam then going to the engine. This would appear to be the origin of the flash system, as adopted by Serpollet, and as used by him years ago in steam motor cars.

It is interesting to note therefore in regard to the critical pressure boiler, that the writer of the article states: "It follows therefore that such a boiler could be constructed without a drum, and might consist merely of a length of heated tube, the water forced in at one end coming out as steam at the other." Such is virtually the Serpollet plan, and I myself have successfully employed it for a pressure of 1000 lb. per square inch in a four-cylinder compound engine fitted to a motor vehicle. With that pressure there was never at any time the slightest sign of water in the exhaust. I have had no experience with pressures of 3000 lb. and over, but I am rather mystified as to the manner in which the assumed possibility of the very highly superheated steam returning to water is obviated in the case of the Benson boiler which was erected at the works of the English Electric Company, Ltd., at Rugby, in 1922. It is stated in the article that steam was generated at 3250 lb. per square inch, and that it was throttled down to 1500 lb. per square inch, being at that pressure superheated to about 800 deg. Fah. Consequently, seeing that it is the very high temperature, and not the pressure, as such, which tends to cause the steam to return to water, it would appear, *prima facie*, that the practice of reducing the pressure and reheating the steam to the temperature corresponding approximately to that of the initial—and critical—pressure, cannot improve matters. That it actually does effect the desired end means surely that it should be practicable, if desired, to employ the steam in the engine at its initial pressure and temperature.

JOHN RIEKIE.

London, July 19th.

BLACKLEAD.—An entertaining little book, entitled "A Tale of Yesterday, To-day and To-morrow," written by Floyd W. Parsons, has been issued by the Joseph Dixon Crucible Company, Jersey City, N.J., to celebrate the one hundredth anniversary of the foundation of the firm by Joseph Dixon. The author meanders pleasantly amongst scraps of sociological history and blacklead with occasional snatches of philosophy and prophetic glimpses into a future when "the" will have disappeared from the English language, glass will only let you see through it in one direction, and the world will be silent instead of noisy. If Mr. Parsons' information will not always bear critical examination, it is yet presented so light-heartedly that at any rate it may be enjoyed without misgiving by the not-too-critical.

AERONAUTICAL PRIZES.—The Royal Aeronautical Society offers annually a number of valuable prizes for papers. The R 38 Memorial Prize, of twenty-five guineas, is offered annually for the best paper received by the Society on some subject of a technical nature in the Science of Aeronautics, preference being given to papers which relate to airships. Entries must be received by December 31st, 1927, and the closing date for papers is March 31st, 1928. The Edward Busk Memorial Prize is offered annually for the best paper received by the Society on some subject of a technical nature in connection with aeroplanes (including seaplanes). Its value is twenty guineas. The closing date for entries is September 30th, 1927, and the closing date for the receipt of papers is December 31st, 1927. The Silver Medal of the Society is awarded annually for the best paper published in the *Journal* of the Society in the year under review.

THE "SINGAPORE" ALL-METAL FLYING BOAT

SHORT BROTHERS, LTD., ROCHESTER, ENGINEERS

A New All-Metal Flying Boat.

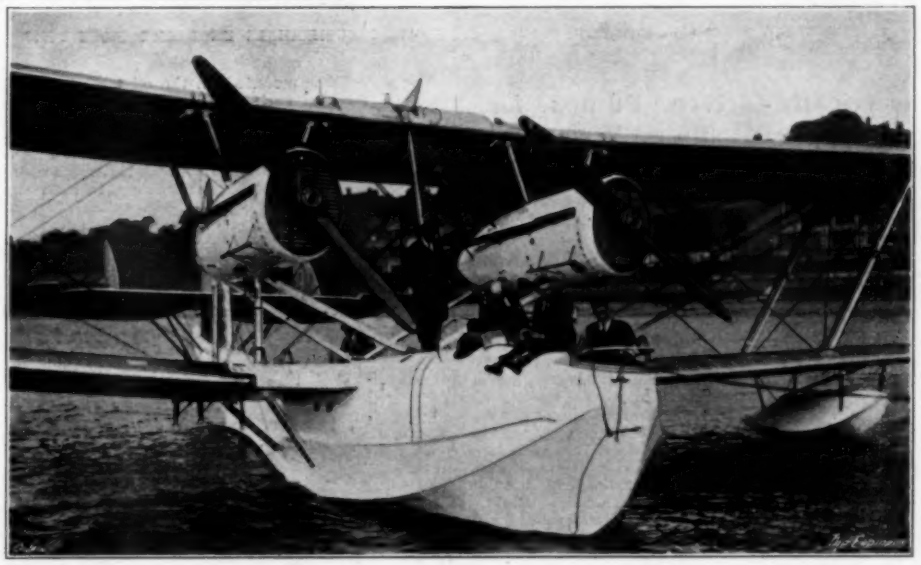
IN our issue of January 7th, 1927, reviewing the progress of aeronautics in the preceding year, we referred to a new all-metal flying boat, the largest of its type so far constructed in this country, which Short Brothers, Ltd., of Rochester, had delivered to the Air Ministry. The machine at that date was undergoing its official trials, but as it was on the secret list, it was not possible for us to illustrate or describe it. We were, however, in a position to say that as a result of the makers' own trials of the machine the opinion had been formed that it represented a remarkable advance in flying boat design, and that it opened the way to a considerable development in the size, carrying capacity and range of flying boats constructed throughout of metal. The machine, known as the "Singapore" flying boat, is now on the Air Ministry's "part publication" list, and can consequently be illustrated, but not yet fully described. We are informed that it has passed through its official flight trials in a very satisfactory manner and that it has fully justified the expectations of all connected with it.

The machine, views of which are reproduced herewith, is built entirely of metal with the exception of the plane coverings, which are of the usual linen fabric. The bulk of the metal employed is "duralumin," as supplied by James Booth and Son, of Birmingham. In addition, non-rustable steel is used in many places for special fittings. With the exception of the steel, all the material is treated by the anodic process, and afterwards painted in a special manner evolved by Messrs. Short. Several years' experience with this treatment has satisfied the firm that it prevents corrosion, and that by its adoption the upkeep of metal flying boats may be expected to cost much less than that of boats constructed of wood.

The main principle of construction embodied in the "Singapore" was evolved by Messrs. Short in 1919, and differs materially from that used by continental builders of metal aircraft. In the Short system the hull is built on the monocoque principle. The system adopted is claimed to be the most economical from the point of view of obtaining the maximum strength from a given weight of material. It also provides a hull in which there are no internal obstructions, and which gives the greatest amount of accommodation for the crew and equipment. At the same time it lends itself to the mass production of the hulls, for it enables them to be built in complete separate segments, which are subsequently joined together in a simple manner. Not the least advantage attending the employment of metal for the construction of flying boat hulls is the fact that such hulls are perfectly water-tight, and are immune from the soakage of water which, after a time, seriously reduces the carrying power and range of boats provided with wooden hulls.

The "Singapore" is driven by two "Condor" Rolls-Royce engines of 650 horse-power each. We are informed that it can fly with full load on only one engine and that this performance is probably a record for a twin-engined machine. It has been designed for reconnaissance work and to fulfil at a greatly reduced cost some of the duties normally carried out by cruisers, such as the protection of coast lines and trade routes in time of war. In the air the machine has proved to be very stable, and, so we understand, it has been found possible to fly it for considerable periods without the controls being touched. This stable condition obtains at all speeds within the flying range. It is claimed that the difficulty previously encountered in the operation of the necessarily extensive control surfaces of large flying boats has in the "Singapore" been completely overcome, and that the machine is as readily manœuvred as any small machine of good manœuvrability.

The "Singapore" is stated to be the first all-metal flying boat built by British constructors to be acquired by the Royal Air Force. In some respects its design resembles that of the large commercial flying boats which Messrs. Short have under construction for Imperial Airways, Ltd., and which we illustrated by a line drawing in our issue of January 7th, 1927. The commercial machine is driven by three Bristol "Jupiter" engines. The service machine has been specially designed to take either two "Condor" engines, as illustrated in our engravings, or three "Jupiter" or three Napier "Lion" engines.



ENGINES AND HULL OF "SINGAPORE" FLYING BOAT

AMONG the principal articles to be exhibited at the second International Fair at Salonica, to be held from September 18th to October 3rd, 1927, are machinery in general, turbines, motors, tools and spares, and electrical apparatus, dynamos, motors, transformers, lighting and heating appliances, and tools.

ELECTRICALLY-DRIVEN VERTICAL MARINE PUMPS

W. H. ALLEN, SONS, AND CO., LTD., BEDFORD, ENGINEERS

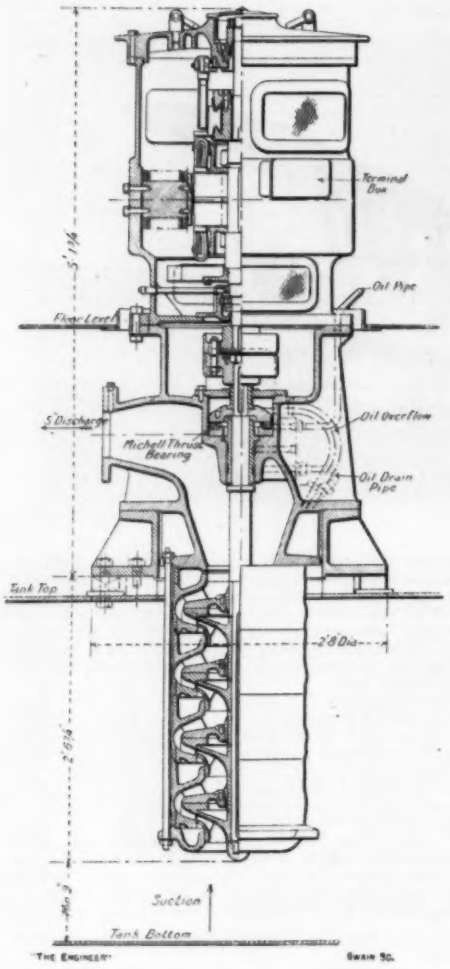


FIG. 1—FOUR-STAGE FORCED LUBRICATION PUMP

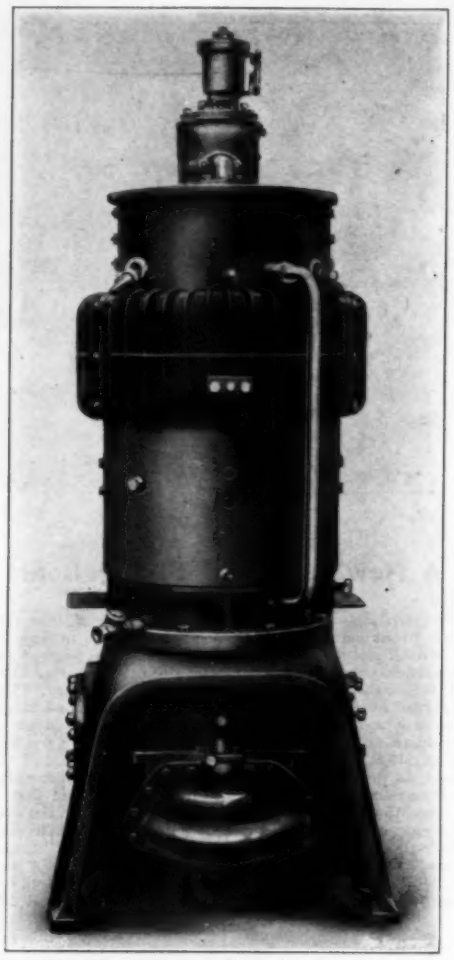


FIG. 2—SUBMERSIBLE EMERGENCY BILGE PUMP

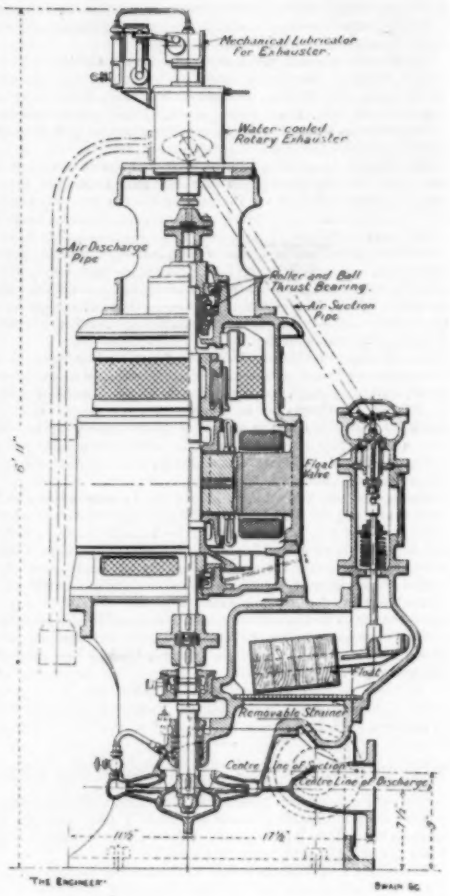


FIG. 3—BILGE PUMP WITH SELF-PRIMING DEVICE

Electrically-driven Pumps for Marine Auxiliary Work.

THE introduction of large-power oil engines for the propulsion of ships and the increasing use of electrically-driven engine-room auxiliaries has altered to a marked degree the design of pumping machinery aboard ships. Such a change in design is noticeable not only in the machinery of our larger motor ships but also in several of the newer liners and cargo vessels in which steam machinery is installed.

In general, the piston type of pump has now given place to the centrifugal pump, which is generally of the vertical type, coupled direct to a vertical spindle motor. By such means a very great saving in space is achieved, and smaller and more compact units may conveniently be employed. During a recent visit to the works of W. H. Allen, Sons and Co., Ltd., at Bedford, we inspected a series of marine pumps going through the shops and under test, and in what follows a brief description of some representative pumps will be given.

Pumping duties aboard any ship, particularly those in a motor vessel, are very varied. They include forced lubrication pumps, fresh and salt water, piston cooling, and jacket pumps, as well as ballast, bilge, and emergency bilge, pumps and pumps for such general duties as fire and sanitary services.

Forced Lubrication Pumps.—The pumps for forced lubrication are very important for large oil engines, and for this special service vertical spindle pumps are admirably suited, and effect a great saving of space, especially in pumps for moderate and large outputs. The pump we show in Fig. 1 is a 5in. four-stage Allen unit of the vertical spindle multi-stage centrifugal type, which is designed for outputs up to 60 tons of lubricating oil of 0·9 specific gravity per hour, delivered against a total head up to 44 lb. per square inch. As the power absorbed by the motor is considerably larger when starting up with cold oil than it is when this oil has been warmed up, and its viscosity decreased, a variable speed motor is employed. In the pump illustrated in Fig. 1 a 24 B.H.P. 220-volt motor, which is designed for a speed range of 1100 to 1300 r.p.m. is used. Larger pumps have been supplied by the firm for use on the R.M.S.P. motor liners Asturias and Alcantara for similar heads, but in those ships 9in. four-stage pumps with an output of 250 tons each per hour are installed

From Fig. 1 it will be seen that the pump itself is suspended from a circular pedestal and projects into the oil tank, so that it is completely immersed in the oil, no priming apparatus of any kind being required. The pump is of the turbine type, with a cast iron casing and guide rings, and with a cast iron impeller mounted upon a steel spindle. The latter depends from a circular cast iron pedestal of substantial design, which also forms the discharge bend, and carries a Michell thrust bearing for supporting the weight of the revolving parts of the pump. The pedestal is mounted on the oil tank top, and is generally made of such a length that the top flange to which the driving motor is bolted is level with the engine-room floor.

An enclosed-type drip-proof ventilator motor is as a rule employed, and it drives the pump through a coupling of the flexible type. The arrangement is both simple and efficient, and it will be seen that very little floor space is taken up. In Fig. 4 we reproduce some test results which were recently obtained on a 5in. four-stage lubricating oil pump of the pattern we have described.

An important feature of the design is the ease with which the pump may be lifted out for inspection and dismantled, and we are informed by the makers that a pump

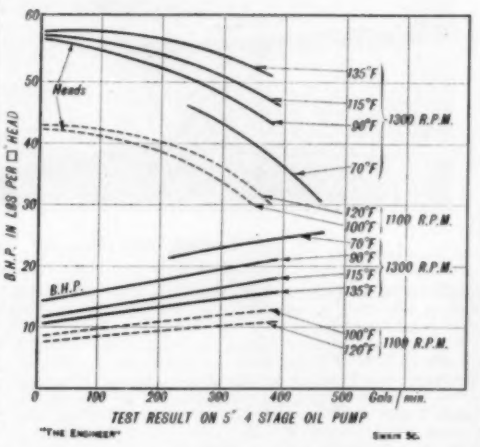


FIG. 4—CURVES SHOWING TEST RESULTS

of the particular type referred to may be completely dismantled in the very short time of thirty minutes.

Illustration Fig. 2 shows another interesting type of marine pump which has been specially designed to meet the Board of Trade requirements for emergency bilge pump working. Such a pump must be designed so that it can continue to work and to deal with a suction lift in other parts of the ship, even although the compartment in which the pump itself is placed may be completely submerged.

In some designs of pumps which have been built for such service the electric motor has been completely enclosed in a closed bell-shaped chamber, and the air pressure generated in the submerged bell by the water outside is depended upon to protect the motor from damage by water. Messrs. Allen have tackled and solved the same problem in a different way by employing other means. As shown in Fig. 2, a completely enclosed type of motor with radial cooling fins is used, and arrangements are made to deal with any water which may leak through the motor gland when the pump is completely submerged. This pump is also fitted with a positive self-priming device, to which we shall refer later in detail. It consists of a Reavell-type exhauster, which is fitted on the top of the pump and is mechanically lubricated. This exhauster is made to draw air either from a float chamber on the suction side of the pump or from a drainage chamber immediately below the motor, which is connected by a long uptake pipe to atmosphere at some high point in the ship. When the exhauster has removed the air from the suction side of the pump and primed it, an automatic valve operated by the float gear, shuts off the connection to the float chamber, and opens that to the drainage chamber, from which a small supply of atmospheric air can be drawn to ventilate the exhauster. Any water which may leak into the motor chamber, either through an insecurely made joint between the exhauster casing and the motor casing, or through the motor gland, is dealt with by a single impeller drainage pump, which is arranged immediately below the driving motor and within its enclosed casing. Drainage water finds its way to this pump, and is delivered through a pipe carried to the base of the main unit and fitted with a non-return valve. This drainage pump also deals with any moisture which is carried over by the exhauster.

The details of the self-priming gear are shown in Fig. 3, which illustration represents a 4½in. non-submersible bilge pump fitted with the self-priming arrangement. It is designed to deal with 224 gallons of water per minute, against a total head of 75ft., and runs at a speed of 1500 r.p.m. The motor is a 10 B.H.P. unit of the enclosed ventilated type, which drives the pump fixed below it. Above the motor and driven through a flexible coupling is a water-cooled rotary exhauster of the Reavell rolling drum type, which is fitted with sliding vanes of stainless steel. As the exhauster is designed to run continuously when the pump is in operation, a mechanical lubricator is fitted to the top of the pump. The water jacket on the exhauster serves to dissipate any heat which may be generated after the pump has been fully primed and the exhauster is dealing with only a small quantity of air.

On the suction side of the pump as shown to the right of Fig. 3 there is a large float chamber arranged above the suction branch. In it is a removable strainer grid which keeps back any foreign bodies that might damage the pump or the float mechanism. The float is of the solid type, and is constructed of a specially impregnated hard wood. It will be seen that the vertical spindle attached to the float is spring-controlled, and is attached to a double-seated vertical valve with rubber faces. Above the valve is a spring toggle arrangement, which is so arranged that the float is only stable in either of its extreme positions of travel. This means that when one of the valves is open the other is shut, and *vice versâ*. When the exhauster has drawn the air from the float chamber the water rises

in this chamber and closes the air connection to the exhauster by means of the valve. The exhauster now draws a small supply of ventilating air from the atmosphere, and the power required to run it is correspondingly reduced.

We inspected some of these pumps on the test bed at the makers' works, and they were shown to be capable of dealing successfully with very large air leaks, the self-priming device being quick and positive in its action.

In Fig. 5 we illustrate a standard type of Allen motor-driven, vertical spindle centrifugal marine pump for salt water circulating service or other general ship's work. It will be seen that the motor is mounted on a semi-circular

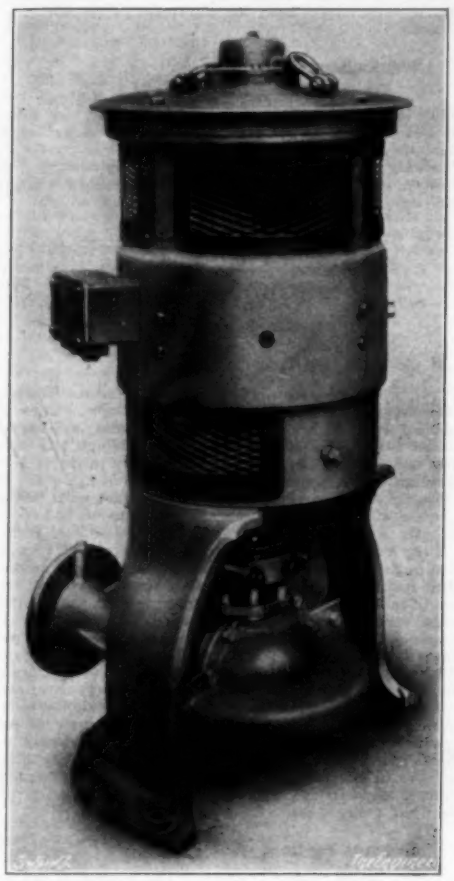


FIG. 5—SALT-WATER CIRCULATING PUMP

base of substantial design, in which the pump itself is housed, and which also carries the pump connections. The casing is split vertically, so that the impeller can readily be examined without dismantling other parts of the pump.

From what has been said in the foregoing article it will readily be understood that vertical spindle centrifugal pumps of the Allen type are now designed to deal with all types of marine service.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

BUSINESS on the Midland iron market "hangs fire," consumers of iron and steel awaiting, in the first place, lower prices and, in the second, the resumption of work after the August holidays. With the works closing down in most cases for a whole week, requirements at the moment are small, and though stocks are low in a good many directions, no concern is felt on this account. With supply greatly in excess of demand, it is not likely that any scarcity of materials will be experienced for a long time. Prices, too, are hardly likely to advance, but, on the contrary, there is a considerable possibility of a further fall. Under these circumstances one can understand the present disposition on the part of buyers to sit tight and await developments. What little material has changed hands this week has done so, for the most part, at the rates prevailing a week ago. Here and there special terms may have been arranged on account of individual circumstances, but market values are substantially unchanged.

Steel Prices.

Much interest has been aroused in Midland engineering circles by the calling of a special meeting of the Steel Manufacturers' Association for this week. What the purpose of the meeting is has not been stated, and up to the time of writing it had not taken place. It is inferred, however, that members are being called together before the regular September meeting to consider whether something should not be done in the meantime to relieve the market deadlock and to cope with the increase of competition from the Continent. Purchases of structural steel have this week been particularly restricted, in view of the expectation that the calling together of the manufacturers would result in a revision of the rates ruling. Producers have not ceased to protest, however, that there is no justification for reducing prices. Some mills have even refused orders at the current minimum, unless they carried extras which averaged up the return. It is pointed out, however, by consumers that whereas pig iron has reverted to about the rates ruling before the coal stoppage, and finished iron has fallen below that level, structural steel is still 12s. 6d. higher. Steelmasters retort that steel had sunk to an unprofitable price before the conflict in the coalfields, and that until recently there had been no such reduction in fuel prices as would warrant larger reductions in steel prices than had already been conceded. There is another factor to be considered, however. The position has to be viewed in the light of the aggressive foreign competition with which our steelmasters are faced. Continental steel, both half-products and finished material, has been coming into this country in large quantities for a considerable time, without any effective reply being made by mills at home. Steelmasters are beginning to realise that if we cannot produce on terms of greater equality than we have been able to do in recent years, there is little possibility of finding employment for the resources which we possess in men and machinery. British mills are finding increasing difficulty now that arrears are being overtaken in disposing of their output. Negotiations at the opening of the new quarter have been ominously unproductive, and it is evident that matters cannot be allowed to drift. The problem must be tackled, and steps must be taken to ensure more native material being used than is at present the case. In this connection the recommendation that foreign plates and sheets, flats, bars, hoops and strip, rails and sections should be required to bear an indication of origin when sold in the United Kingdom is being endorsed as a step in the right direction. This week local mills have been keenly competing for such orders as have come on the market, but buyers are content to purchase on a hand-to-mouth basis. A few contracts for constructional steel are being arranged, but engineers report a general slackening of demand. It is generally anticipated, however, that should the Association decide to revise its basis in consumers' favour, a considerable volume of business will be forthcoming, if not immediately, then as soon as the works settle down again after the August holidays.

Pig Iron.

Consumers of pig iron in the Midlands show no inclination to place orders until after the holidays. Hardly any new business was forthcoming at to-day's meeting in Birmingham, and the general view in well-informed circles is that no real revival can come about until prices have been stabilised. There has been no further weakening of values this week, Derbyshire No. 3 foundry being quoted firm at £3 7s. 6d., and Northamptonshire foundry £3 2s. 6d. Smelters contend that values have already fallen below the profit-making basis, and are not disposed to make concessions, but unless they can sell the make at present market levels, they are faced with increasing stocks and further curtailment of output. The blowing out of furnaces on the North-East Coast, although insufficient to leave output on a level with demand, has helped in the steadying of pig iron values, Cleveland No. 3 being maintained at £3 10s. per ton. East Coast mixed numbers are fairly plentiful at £3 16s. per ton. Midland steelmakers are not absorbing as much iron as a few weeks ago, and pig iron stocks are increasing. Smelters are undecided whether to blow out furnaces or to carry on in anticipation of a better demand developing next month.

Finished Iron.

The Staffordshire finished iron trade shows no improvement. Business remains sluggish and of small content. The marked bar houses are rather better placed than the makers of Crown and common iron, but even in this department there is insufficient work to keep mills regularly and fully employed. Common bars used for nut and bolts and fencing are obtainable at about £9 15s., but Belgian No. 3 iron is available at £6 delivered in the district, and most consumers are buying the foreign product. Marked bars are unchanged at £13 10s., and Crown bars at about £10 10s. Ironmasters are hoping that when the holidays are over and work settles down again in September a real improvement in demand for iron for special engineering requirements will develop, and that they will have less cause for complaint than has been the case for many months past.

Galvanised Sheets.

In the galvanised sheet trade the mills could do with more orders, and are shading prices to get the business. For 24 gauge corrugated the basis is £14 per ton, but this figure is barely maintained. Reports from South Wales of an improved demand are not borne out by the experience in this district. Some export business has been done, but not enough to allay the anxiety of millowners whose order books are ill-furnished.

Scrap.

The market for scrap remains scanty and little material is being disposed of. Midland works offer supplies of heavy steel scrap as low as £3 5s. per ton delivered South Wales.

Engineers' Wages.

Engineering employers in the Midlands express satisfaction at the ending of the wage dispute in the engineering industry. For the past three years they have been uncertain whether a stoppage of work would eventually take place, and the worries of business have been increased by this uncertainty. For the next six months peace with their employees should be assured. It is felt that while working engineers are not too well pleased with the terms of the settlement, the union leaders have some reason to feel satisfied. They have managed to avoid what would have been a disaster both to the unions and to the country—a strike or lock-out. They have persuaded their members that in an industry constantly faced with serious foreign competition, to cease work is in the long run to lower and not to raise wages, and they have secured a general increase of 2s. a week in the bonus to time workers.

High Wages Strike.

After lasting ten days, a settlement was arrived at on Saturday last of a most remarkable strike. The stoppage has become known as "the Birmingham strike against high wages." Several hundred ironmoulders employed by John Wright and Co., Ltd., manufacturers of gas cookers, &c., of Aston, Birmingham, came out on strike on July 13th because one of their number earned 1s. 9d. per day more than the limit of 23s. 6d. per day which their trade union—the Ironfounding Workers' Association—sought to impose upon earnings. It ended in an agreement that "there shall be no restriction placed upon individual output or earnings." When the avowed objects of a trade union are to improve the standard of living of its members, it is difficult to understand why it should object to one of its members improving his own standard by 1s. 9d. One can understand a trade union fixing a minimum, and saying that no man must work for less than a stated sum, but one fails entirely to grasp the rights of a policy which fixes a maximum and says no man must receive more. To stop work in protest against the earning of high wages is surely the reduction of trade union principles to the extreme of absurdity.

Road Transport and Canal Bridges.

Steps continue to be taken in the matter of bringing up to date Black Country canal bridges and avoiding the restrictions to heavy works traffic over existing bridges which the notices posted by the Birmingham Canal Navigations threaten. In my letter in your issue of June 10th I gave prominence to this very important matter, and pointed out that unless satisfactory measures were adopted to strengthen and widen these bridges sufficiently to enable them to carry present-day loads, transport could not be effectively carried out at many of the iron and steel works in this area. The question has been taken up by the local Chambers of Commerce, a deputation has waited upon the Ministry of Transport, and, more recently, a meeting of the Association of Midland Local Authorities has gone thoroughly into the question. At that meeting it was decided to ask the canal companies to delay enforcing the notices they have given restricting the use of canal bridges, and to suggest to them that they should co-operate with local authorities in any temporary measures which might be necessary to restore freedom of traffic, pending a permanent settlement. A special committee was also appointed to deal further with the question. It is hoped that success will reward these efforts, and that in the near future we shall have bridges brought up to the same high state of efficiency as the roads of which they form such vital links.

Darlaston Firm's Steel Contract.

I learn this week that Rubery, Owen and Co., Ltd., Darlaston, Staffordshire, have secured the contract for the steelwork required in the erection of the new Underground Electric Railway offices in Broadway, Westminster, London. Approximately, 3200 tons of steelwork will be used in the framework of the building, which is estimated to cost £300,000. A great deal of steelwork will be required underground as well as above ground, as the building is to be placed upon a sub-structure, the contract including the steelwork for both the sub-structure and the superstructure.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The General Outlook.

ONE favourable result of the acceptance by the men of the wages offer of the employers in the engineering trades will be freedom from the clouds of uncertainty which the possibility of labour troubles creates. In the Lancashire district there is still keen recollection of the worrying early months of last year caused by the threatened stoppage of work in the engineering trades, a danger which, curiously enough, was only averted by the more serious, but short-lived general strike and the prolonged coal dispute. Locally, conditions in the engineering industries to-day, taking a broad view of the situation, are not satisfactory. Probably the two branches that are more happily situated than the others are those concerned with the production of heavy electrical machinery and constructional engineering, although more than one firm engaged in the latter have orders on their books that allow little, if any, margin of profit. Some of the well-known Lancashire concerns that make specialities of various kinds are also not unfavourably placed. On the other hand, the home market for textile machinery shows no improvement, and makers of it are compelled to rely increasingly on overseas outlets, whilst the machine tool and the boiler-making sections are among others that are having a relatively trying time.

Non-ferrous Metals.

An interesting fact relative to the movements of the non-ferrous metals during the past week is that all varieties, at the time of writing, show an appreciable improvement in values compared with last report. On balance, cash tin is more than £3 per ton higher than it was a week ago. Unfortunately, this improvement is not due to any expansion of the trade demand in this country, for here, as well as in America and on the Continent, consumers are buying cautiously. Rather, is it because that, in a market that is essentially speculative, the "bulls" are temporarily on top. In the case of copper market conditions are regarded as healthier, with rather freer buying by industrial interests here and in other centres, the net result being an appreciable recovery in values. Largely in sympathy with tin and copper, although to some extent because of returning confidence in the metal itself, lead has shared in the better tone of the market, and here also current quotations have registered a gain, and are now back almost to where they were a month ago just before the last decline set in. Whilst speculative interest has been a prominent feature, genuine trade

buying is believed to have been on healthier lines. The demand from industrial users of spelter remains quiet, although closing prices for that metal are somewhat better than at last report.

Iron.

From the chorus of general complaints regarding the state of trade in the iron and steel markets here, it is refreshing to find one or two sellers of foundry iron who, prior to the present week, have had a fairly good run of business—in one case the period given is five weeks. This, of course, dates from the time when values in this section had obviously nearly reached rock bottom, resulting in the re-establishing of confidence among users and a flow of new orders which, though not particularly heavy in the aggregate, were relatively satisfactory after the dull period which the market had experienced. This week, however, business has been slow again, but as this and next week are normally dull, sellers are not unduly concerned. As a matter of fact, there is a quietly confident belief that by the end of next month there will be a fair amount of contract buying going on. Values, in the meantime, seem to be steadier all round, with Staffordshire brands at about 76s., Derbyshire at 75s. 6d. to 76s., Middlesbrough at 83s., Scottish at 95s. upwards, and hematite at 89s. to 90s. per ton, including delivery in the Manchester area in each case. Lancashire Crown bars are maintained at £11 per ton and second quality bars at £10, but the demand for them continues very quiet, and makers are not anticipating any early improvement.

Steel.

With regard to steel, the position is pretty much as it has been for some time now. Buyers, apparently, are still holding out for more favourable prices, and for that reason there is little in the nature of serious forward buying going on. Practically all of the business transacted on this market during the past week has been for early delivery, and as users experience less and less difficulty in securing this, they are not anxious to venture far ahead. Sections and joists are still quoted here at £7 12s. 6d., ship plates being on offer at £8 7s. 6d., boiler plates at from £11 5s. to £11 10s., and steel bars at from £7 17s. 6d. to £8 12s. 6d., the last-named section still showing evidence of weakness. At one time there was a slight burst of activity in the case of galvanised sheets, although it did not last long; the result, however, was a steadying influence on the market at about £14 per ton f.o.b. for the usual Indian specifications. Inquiry from the Far East for thin gauges remains dull, and a fall of 15s. has not been surprising, for business in them has been slow for some time. Bangkoks are now quoted at £21 per ton f.o.b., Shanghais at £22 5s., Straits at £20 and Rangoons at £21 17s. 6d. Continental steels have weakened somewhat on this market, probably in consequence of fairly plentiful offers of cheaper second-hand parcels. Except for a certain amount of buying of "semis," there has been little business of importance passing in this section of the market. For delivery to users' works for cash against documents, continental joists are quoted at £5 15s. per ton, Siemens plates at £7 10s., ordinary plates at £7 3s. 6d. to £7 5s., wire rods at £6 12s. 6d. to £6 15s., steel bars at £5 15s., billets at £5 2s. 6d., and sheet bars at £5 6s. to £5 7s. per ton.

Scrap.

A shade more business has been reported in non-ferrous metal scrap and prices have been steadier in sympathy with the new metals. Scrap lead is on offer at about £23, zinc at £23 10s., clean light copper at £56, heavy yellow brass at £44, brass rod turnings at £39, and selected gun-metal scrap at £52 10s., these prices being for graded qualities and including delivery to buyers' works.

BARROW-IN-FURNESS.

Hematites.

The general position in the hematite pig iron trade of North Lancashire and Cumberland is not changed. There is not much business being done on general home account. Orders are only placed to tide over current wants, and there is no disposition to place contracts for forward delivery. Overseas business is dull. So far as steel makers are concerned, they have been taking good deliveries of metal, both at Barrow and at Workington, but that business will fall away at the end of this week on account of the annual holidays. There is plenty of iron available. No improvement has been brought about by recent cuts in prices.

Iron Ore.

The demand for iron ore is mostly on local account, but a certain amount of ore of best quality is leaving the district by rail and sea. Foreign importations of ore are fair.

Steel.

The demand for steel rails is quiet all round, and there are no signs of any improvement. Orders are held for home and overseas buyers, and deliveries are being made from Barrow and Workington. For hoops there is a steady call, largely on overseas account. Castings are a fair business.

Fuel.

For steam coal there is a fairly good demand, and coke, both from the East Coast and Cumberland, is in request.

SHEFFIELD.

(From our own Correspondent.)

Quiet Conditions Prevailing.

THERE is no substantial buying in iron and steel, and with the holiday influence making itself felt in every direction, conditions are exceptionally quiet. Some of the works have arranged to take a longer holiday than usual next week. Business in open-hearth steel is poor, but with the comparatively few furnaces that were restarted after the stoppage for stocktaking at the end of June, it has been found necessary to bring another furnace into commission. There are now four furnaces working at Templeborough, and three each at Ickles and Stocksbridge. The rolling mills, forges and foundries are carrying on with a fair amount of work, but the position is not satisfactory. No plants are in a sufficiently lucky position to be able to work up to their capacity. When the returns of output for July are available, it will be found that it has proved a bad month, and with the holidays intervening it will doubtless be found that August will be even worse. In the autumn, however, it is hoped that there will be a revival of a marked buying movement. Stocks are certainly low, buyers having proceeded with great caution since they got rid of their coal stoppage obligations, and prices of raw materials are now down to a level which it is calculated should induce business. Many large firms have very wisely been taking advantage of the low-priced fuel now on the market to build up their reserves on favourable terms, and the benefit of this quiet buying will be reaped later in the year. The Association of Wire Rod Rollers has reduced the official minimum quotations for acid rods by 20s. per ton, and for hard basic rods by 10s. per ton. These alterations follow similar reductions on the official prices of billets. Prices of soft basic rods are not controlled and remain around £9 5s. per ton.

Electricity to Replace Steam.

Serious damage to the engine and plant at the continuous wire rod mill at Templeborough was recently caused through the bursting of a huge fly-wheel, and it has been decided to replace the steam engine with electrical power. The mill is standing idle, and the work is being done in Lancashire. It will be some time before the electrification and repairs are completed.

Railway Work.

In its monthly review of trade prospects the Sheffield Chamber of Commerce reports:—"Various products for railways—axles, springs, framework, &c.—are fairly active and promising. The Indian market is looking up again as regards railway equipment; the South American railways continue to favour British steel; South Africa is turning more to the Old Country owing to recent bad failures of foreign steel; and New Zealand will be buying much more British steel and products, especially for railways, in the coming months. Most of the new £6,000,000 loan is to be spent on railway extensions and renewals, and British firms are practically sure of the whole of the business involved. At home there is a considerable demand for builders' castings and general ironwork; wire is a moderate line; special steel sheets are in good request; pipes and tubes are healthy, though these are not strictly Sheffield goods; small castings and parts and shapes for electrical engineers are in good demand, and the same remark applies to tram and omnibus parts and fittings."

Plate and Cutlery.

Business in cutlery and silver and electro-plate ware continues to be quiet, and a slump in the home market appears to account principally for the position The various markets overseas are being held, and in some cases developed, and there are signs that the selling reorganisation that has taken place in recent years in important centres is having the desired effect. A Sheffield firm has secured a large contract from the Cunard Company for spoons and table plate. The making of safety razor blades develops in an encouraging fashion, and the latest firm to install a plant in the city is the Dominion Steel Corporation, Ltd.

Chromium Plating Plant.

A process which undoubtedly has a great future is that of chromium plating, which can be applied to anything now produced in silver or ordinary electro-plate. The process gives a highly polished silver appearance, and its main attraction lies in the fact that it is stainless. A well-known Sheffield firm, John Townroe and Sons, silver platers and gilders, have installed a new department for this chromium plating, and work was commenced last week after an experimental run. The deposit in this form of plating is harder than silver, and it is of particular value for such articles as spoons and forks, hotel and restaurant ware, taps, and motor and ship fittings. The plant which this firm has installed, by the way, is of all-British make.

Colliery Developments.

A scheme for the amalgamation of two Sheffield colliery companies, the Sheffield Coal Company, Ltd., and the Aston Coal Company, Ltd., has been approved by the Railway and Canal Commission under the Mining Industry Act, 1926. In giving judgment the Court expressed the opinion that the amalgamation was in the national interest. In the statement in support of the application it was mentioned that for some time past it had been felt that these two collieries, which were controlled largely by the same Board, ought to amalgamate their undertakings. The reason was obvious, as the coalfields were adjoining. They had a single problem, and they felt that instead of having two separate collieries which were divided by the boundary now existing and created by the leases of the two companies, they would do much better by amalgamation. They would be able to eliminate the barriers and to lay out a much more efficient method of working their coal if they sank a shaft which was capable of drawing coal from a part of both areas instead of from one. From a mining point of view, the joining of these two areas was essential. Under the Trade Facilities Act an agreement was arrived at between the Sheffield Company and the Treasury by which the latter agreed to guarantee a loan of £250,000 provided that the Sheffield Company satisfied the Government on certain points, the most important of which was that the Sheffield Company should acquire the whole of the undertaking of the Aston Company and of the Beighton Ovens, Ltd., a coke-producing and by-products undertaking which lies in the middle and derives its sustenance, so to speak, from the other two companies. Before the Treasury would guarantee any loan it intimated that it must be satisfied that the Sheffield Company had raised from public or private sources at least £200,000 of additional capital. The scheme of colliery development was estimated to cost, according to the Treasury agreement, not less than £400,000. Evidence was given, however, to show that it would cost £450,000. It was proposed to issue new capital for the Sheffield Company to the extent of £200,000, and as soon as that had been done, it would issue the debenture loan, which was to be guaranteed by the Treasury. The output of the two companies under the amalgamation would be increased from 700,000 tons to 1,250,000 tons a year.

New Railway Sidings.

The London and North-Eastern Railway Company has authorised a scheme for providing new sidings at Boston, so that 104 additional wagons can be accommodated. The opening of a new sugar beet factory at Spalding has led to a large increase in traffic passing through Boston, and there will be a still further increase when the new beet factory at Bardney is opened in the autumn.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

PRODUCERS of Cleveland pig iron are becoming increasingly anxious regarding the outlook. They are getting well through with contracts on hand, and business shows little or no signs of reviving, although the period has now arrived when a move is usually made to cover autumn requirements. At all events consumers are not showing any disposition to test the market with forward contracts, and seem content to continue on a hand-to-mouth basis. Many consumers, it is stated, are holding off the market in anticipation of an easier trend in prices, but makers appear to be as determined as ever not to make any further concessions. Though there has been some slight relief in the cost of producing pig iron, they contend that ruling prices still entail a loss. Stocks at makers' works continue to increase, and the possibility of two more blast-furnaces being put out of operation is reported. The effect of this action would be to reduce the number in operation on the North-East Coast to thirty-seven, and, by restricting output, give additional substance to the determination of producers to maintain present price levels. Only a few export inquiries are circulating, and most of the sales recorded are for small lots to home consumers to meet pressing needs. No. 1 Cleveland foundry iron is 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d. per ton.

Hematite Pig Iron.

Quiet trading conditions also prevail in the East Coast hematite pig iron trade. The very small output is more than ample to meet the moderate demand, and producers are as keen as ever to reduce their rather heavy stocks. Quotations are irregular, with a somewhat marked downward tendency. Mixed numbers are now being pressed on the market at 75s. 6d. per ton, and 76s. is quoted for No. 1 quality.

Ironmaking Materials.

Consumers of foreign ore having large and steadily increasing supplies are off the market, and quotations are nominal on the basis of best Rubio at 21s. 6d. per ton c.i.f. Tees. Blast-furnace coke is slow of sale, consumers anticipating a fall in values and consequently buying very sparingly. Good medium descriptions are put at 19s. per ton delivered at the works.

Manufactured Iron and Steel.

Continued dearth of new business, while many contracts in hand are fast approaching completion, is the outstanding feature of the manufactured iron and steel trade. Manufacturers are very keen to secure business, but they are reluctant to lower prices. There is a slightly increased demand for shipbuilding requisites, but other sections of the steel industry remain very quiet. Prices, however, are firmly maintained.

The Coal Trade.

The general situation in the Northern coal trade is a little more encouraging, a feature in the last few days being an increased export inquiry, especially from Italy. That country is a large buyer of English fuel, and current prices are evidently keeping the offers of rival producing nations well in check. The prospective orders circulating are for numerous separate cargoes rather than large quantities over a period. If collieries were inclined to sell forward at present prices they could doubtless do a good trade, but this is a very doubtful policy having regard to the economic state of the industry. If a succession of official ascertainments on the subject of proceeds and costs has suggested anything, it is that the pits could not go on producing indefinitely at the prevailing low prices. Thus a good many pits have been compelled to close down. A lessened output and a better inquiry will, it is hoped, have the effect of firming up values and so ultimately help the collieries to get along without a deficiency. Cumulatively, this is now very heavy in both Northumberland and Durham. In the circumstances, direct sellers are not, with few exceptions, prepared to negotiate beyond early shipment dates, so as to be ready to take advantage of any improvement that may take place in the market. The general outlook for August is encouraging, even if the actual business being done is still limited. The chief thing is that inquiries are broadening out, and buyers are more intent on English coal, their only concern at the moment being as to how cheaply they can get supplies.

Engineers' Wages.

A claim for an advance of 5s. per week for all workers in the engineering industry was made upon non-federated employers in the Tees-side and Darlington districts at a conference between the parties at Middlesbrough on Wednesday. It was contended by the men's representatives that the industry in the area was in a more prosperous condition than any other section of the engineering industry in any other part of the country. The employers, however, pointed out that many of the orders had been booked below cost in order to keep their establishments going, and stated that they could not improve upon the offer that had been made by the national employers of 2s. per week for plain time workers. In accepting the offer the men's representatives intimated that they did so reluctantly.

Coal Market Firm.

There is a distinctly firmer tone in the coal market, especially for prompt deliveries. Fitters are well stemmed, and in a better position than for some time past. The prompt inquiry is good, and prices are firmly maintained. All qualities of Northumberland steam coals are in demand and steady in price, both direct and in second hands. Best Blyth steams are stiffly held at 14s. 3d., and through contractors are very difficult to discount on this figure. Best Durham steams remain a quiet section of the market; large at 16s. and smalls at 12s. A sale of a medium size cargo of ordinary secondary Durham gas coals was made this week by merchants for shipment to Genoa at 20s. 5d. per ton c.i.f., which is regarded as extremely low, owing to the higher freights. The gas coal position, however, is steadier, and buyers find it difficult to obtain discounts. Best qualities are fully 16s., and in some cases up to 16s. 3d. is quoted. Coking coals are steady for export, but with a small home consumption, prices remain weak at a nominal 14s. for good classes. The bunker coal position is holding steadily, and supplies are easily cleared at 14s. for good grades, and 14s. 6d. to 15s. for superiors. There is an increased demand for gas coke, and prices are hardening in view of slowly dwindling stocks. Best grades are 19s. 6d. to 19s. 9d., and ordinary kinds 19s. to 19s. 3d. Foundry cokes are steady, and output is readily cleared. Good patent cokes are 18s. to 20s.; special makes, 24s. to 26s.; beehive makes, 28s. to 30s.

SCOTLAND.

(From our own Correspondent.)

Holiday Markets.

BUSINESS has been practically at a standstill in the steel, iron and coal industries during the past week owing to the annual holidays. Markets have been poorly attended, and prices have not been tested. The collieries have restarted, but many of the steel and ironworks will be closed until next week, in view of the quiet state of trade.

The Outlook.

The general outlook for the next few months at least is none too promising. Progress at the shipyards may be steady, but is nevertheless slow, and specifications for all classes of iron and steel materials are difficult to secure, and in this respect the competition from foreign sources makes the task of securing orders almost in some cases a forlorn hope. Some branches of the trade, such as structural engineering and locomotive building, are comparatively well placed, but the all-round aspect is far from promising. The situation in the coal trade is much the same. The demand for round coal for export has gradually dwindled, while prices have receded until the reduction of outputs on a drastic scale has become necessary. The situation shows little promise of improvement, and here, again, competition in foreign markets is most severe. Existing industrial conditions have wrought havoc with the home coal markets, and the efforts of collieries to maintain prices have been vain. Now and then a feeling of optimism has crept in, but it has been difficult to trace the source of such feelings, which, as a rule, subsequent events have proved misleading. High costs and keen competition are rampant, and there seems little reason to anticipate an early change from the element of caution which has actuated buyers and sellers for some time back.

Wages in the Iron Trade.

The Conciliation Board for the regulation of wages in the Scottish pig iron trade has received intimation that the wages of workmen will drop 2 per cent. on basis rates, in view of the fact that the average net selling price of pig iron has been certified as £4 3s. per ton.

Locomotive Contracts.

It has been reported that the North British Locomotive Company, Glasgow, has received an order for twenty-four locomotive boilers on behalf of the Buenos Aires and Pacific Railway. The same firm recently secured an order for forty locomotives from the Egyptian State Railways.

Steel and Iron.

Practically all the steel and iron works continue on holiday throughout the present week, and the markets are devoid of interest. Meantime, attention will be given to the necessary repairs and renewals in connection with plants.

Coal.

The collieries have now resumed operations, but progress is likely to be slow, owing to the existing stagnation in the industry. Prices are nominally unchanged. Aggregate shipments for the past week amounted to 124,873 tons, against 277,403 tons in the preceding week and 262,859 tons in the same week in 1925.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THERE has not been a great deal of change in the general state of trade in steam coals, but the loading position is better. At the end of last week there were as many as thirty-nine idle loading appliances at the various docks in this district, but as the result of arrivals of tonnage over the week-end the situation was much improved. On Monday no less than ten steamers were waiting for berths. There is a mild rush to get steamers loaded and sailed before the holidays, but even this slightly extra pressure is insufficient to have any material effect upon values, although small coals are steadier owing to the restricted working at the pits and the fact that collieries will be stocking a portion of their supplies for their own boiler purposes. On the whole, the position of many collieries is still very bad, and notices continue to be served upon miners at various pits terminating their contracts. The probability is that for another month or so no perceptible improvement in the conditions in the coalfield will be observable, and it will be the autumn before the expansion in the demand, which is looked for, will materialise. Shipments last week amounted to 433,522 tons, which compared with 445,308 tons in the previous week, but it is likely with increased supplies of tonnage at the docks returns for the current week will mark an advance. Certainly, chartering of late has been more active, and for the week ended the 22nd inst. the total amount of tonnage taken up for loading in this district came to 314,370 tons, which compared with 270,170 tons for the previous week. For one thing charterers are booking up steamers as far ahead as possible in anticipation of outward rates of freight increasing. Most shippers have by now completed their business for loading not only immediately before the holidays but for next week as well, so that a very quiet time will be experienced until somewhere about the second week in August. It is fully expected that the official holidays in the coalfield will be three days, viz., Monday, Tuesday and Wednesday next week, while so far as the docks are concerned, it has been definitely arranged that Monday and Tuesday next shall be holidays.

LATER.

It is now announced officially that the holidays in the South Wales coalfield next week will be Monday, Tuesday and Wednesday. So far as the commercial side is concerned, the Coal and Shipping Exchange will be closed all day Monday and Tuesday, and from mid-day on Wednesday.

Continental Coal Decrees.

We have already had unmistakable evidence of the difficulties which coal exporters and colliery owners have to contend with in the matter of barriers being raised against them in the shape of the Spanish coal decree in April, which aimed at restricting the importation of British coals into that country. Since that month the volume of trade with Spain has steadily declined, although regard must be had to the fact that, during the first three months of this year, shipments to Spain were abnormally heavy. Then followed the action of the French Government in setting up the system of import licences, and now comes the news that the Portuguese Government contemplates issuing a decree very much on the lines of that in force in Spain, which has for its object making it obligatory upon Portuguese railways and national industries to utilise a percentage of their own coals. This is to come into operation four months after the publication of the decree. The percentage of Portuguese coals to be consumed is to be ascertained every three months, and the decree provides that all fixed and semi-fixed machinery or locomotives that may be ordered shall be adapted, as far as necessary, to allow of national coal being burnt economically. The prices for the national coals shall not be higher than those for the respective British Admiralty equivalents.

Steel Workers' Wages.

On Friday last the figure for the average selling price of Siemens steel bars for the quarter ended June 30th was disclosed, and the effect of the ascertainment is a further reduction compared with the previous ascertainment of 1¼ per cent. on wages under the sliding scale agreement. The new ascertainment is to apply for the three months, commencing August 7th next. On Monday a meeting of steel manufacturers at Swansea decided to decrease the price of tin-plate bars by 5s. from £6 to £5 15s.

New Welsh Reservoir.

On Thursday last Lord Buckland of Bwlch formally opened the Taf Fechan Waterworks at Pontsticill, near Merthyr. The water from this reservoir will be distributed to a population of over 500,000 persons in the districts of the various authorities constituting the Taf Fechan Water Supply Board. The Board is composed of representatives from Merthyr Tydvil, Rhymney Valley, Pontypridd, and Rhondda, Aberdare, Llantrisant and Llantwit Fardre.

Current Business.

Operations on the coal market have been on a moderate scale during the past week and prices generally have displayed very little if any alteration. Large quantities have remained without special feature, but small coals have become a shade firmer on account of supplies being more restricted. No new inquiries of note have come on the market, but it is understood that the Portuguese State Railways have purchased about 20,000 tons of large and small coals for fairly early delivery. Coke is steady, but patent fuel has displayed comparatively little activity. Pitwood is slightly easier.

LATER.

It is now confirmed that the Portuguese State Railways have placed the contract for 20,000 tons of small steam coals with a Cardiff firm, but their order for 10,000 tons of patent fuel has gone to Germany.

CATALOGUES.

HEAD, WRIGHTSON AND CO., Ltd., Norton-road, Stockton-on-Tees.—Booklet on cement works plant.

COOKE, TROUGHTON AND SIMMS, Ltd., Broadway-court, S.W. 1.—List of topographical surveying instruments.

BARFORD AND PERKINS, Ltd., Peterborough.—Catalogue No. 597, giving particulars of all types and sizes of motor rollers.

CHARLES ROBERTS AND CO., Ltd., Horbury Junction, near Wakefield.—Chart showing the capacities of railway tank wagons.

VENESTA, Ltd., 1, Great Tower-street, E.C. 3.—A copy of the Venesta Technical Series No. 2, entitled "Plymax for Coach-building."

BRITISH GOODRICH RUBBER COMPANY, Ltd., 50, Pall Mall, S.W. 1.—Catalogues of "Goodrich" cutless rubber bearings for all purposes.

ATKINSON WALKER WAGONS, Ltd., Frenchwood Works, Preston.—Brochure 59 dealing in detail with "Atkinson-Walker" rail tractors.

THE SILICA COKE OVEN AND MACHINERY, Ltd., Aldwych House, Aldwych, W.C. 2.—Bulletin No. 1 on "Coke Ovens and the New Otto System."

EDGAR ALLEN AND CO., Ltd., Imperial Steel Works, Sheffield.—Booklet giving full details of the Barnes patented floating straight shank twist drill.

WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., 82, York-road, King's Cross, N. 1.—Catalogue Section S 13 dealing with impedance bonds.

A. REYROLLE AND CO., Ltd., Hebburn-on-Tyne.—Pamphlet 667, dealing with metal-clad switchgear, illustrating installations in a number of power stations.

MICHELL BEARINGS, Ltd., South Benwell, Newcastle-on-Tyne.—Catalogue illustrating and describing in detail "Michell" thrust bearings of the marine type.

LEA RECORDER COMPANY, Ltd., 28, Deansgate, Manchester.—Leaflet describing some water gauging and measuring appliances and accessories for civil engineers.

FULLER ACCUMULATOR COMPANY (1926), Ltd., Woodland Works, Chadwell Heath, Essex.—Particulars of house lighting batteries of capacities up to 500 ampère-hours.

HEAD, WRIGHTSON AND CO., Ltd., Thornaby-on-Tees.—Booklet illustrating a number of blast-furnace plants constructed by the company for firms in England and abroad.

HOPKINSON'S, Ltd., Britannia Works, Huddersfield.—List No. 1990 on "'S.P.S.' Valves"; list No. 1920 on "Hopkinson-Ferranti Valves"; list No. 1910 on "Steam Isolating Valves."

THOMAS RYDER AND SON, Ltd., Turner Bridge, Bolton.—Verticalauto catalogue No. 127, giving details and illustrations of the types of work which can be done on the vertical automatic machine made by the firm.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

ELECTRICARS, Ltd., of Birmingham, asks us to announce that Mr. H. R. Simpson, A.M.I. Mech. E., has been appointed as its technical sales representative in London and the South of England.

MR. E. T. ELBOURNE, of 8, Great St. Helens, Bishopsgate, London, E.C. 3, asks us to announce that he has established a Marketing Intelligence Index Service for the benefit of British manufacturers and traders.

DAVEY, PAXMAN AND CO., Ltd., of Colchester, ask us to announce that they have purchased the West Hydraulic Engineering Company, Ltd., of Luton, which has now been transferred to Colchester, where the manufacture of its hydraulic specialities will be continued.

MR. D. BALFOUR, M. Inst. C.E., of Messrs. D. Balfour and Son, asks us to announce that he has taken into partnership his son, Mr. D. Ross Balfour, B.Sc., M. Inst. C.E., and that the firm will be carried on as previously at 18, Abingdon-street, Westminster, and 3, St. Nicholas-buildings, Newcastle-on-Tyne.

THE ASSOCIATED DAIMLER COMPANY, Ltd., of Blackhorse-lane, Walthamstow, asks us to announce that its sales, publicity, and commercial departments, other than design and experimental, will be moved to the new Associated Daimler Offices at Windmill-lane, Southall, Middlesex, as from Monday, August 8th. The telegraphic address will be "Vangastow Southall," and the temporary telephone number is Southall 1502.

THE MANCHESTER ASSOCIATION OF ENGINEERS asks us to announce that Mr. T. Makemson has been appointed secretary of the Association in succession to Mr. Frank Hazelton, who has resigned. The newly appointed secretary commenced his duties on July 1st, on which date the offices of the Association were removed from 16, Albert-square, to St. John-street Chambers, Deansgate, Manchester. Telephone, Central 2178; telegrams, Makemson, Central 2178, Manchester.

R.I.B.A. MAINTENANCE SCHOLARSHIP IN ARCHITECTURE.—The Board of Architectural Education of the Royal Institute of British Architects, in conjunction with the Artists' General Benevolent Institution, offer for award in September, 1927, a Maintenance Scholarship of a maximum value of £100, tenable from October 1st, 1927. The scholarship will be tenable in the first instance for one year, and will be renewable for two further periods of one year each. It is intended to enable the orphan of an architect or artist, or son or daughter of an architect or artist, who has not the necessary means, to attend an approved course at one of the schools of architecture recognised for exemption from the R.I.B.A. examinations. Students who are already taking such a course would not be eligible to apply for the scholarship. Full particulars of the scholarship, including the method of application and selection of the candidate, may be obtained from the secretary to the Board of Architectural Education, R.I.B.A., 9, Conduit-street, W. 1, not later than August 20th, 1927.

STEEL PIPE FLANGES AND FLANGED FITTINGS.—It is the practice in the United States to issue standard specifications in a tentative form so that they may be open to public criticism before being reduced to their definitive shape. A specification of the kind for steel pipe flanges and flanged fittings has just been circulated in America. The flanges and fittings are deemed suitable for steam pressures from 250 lb. up to as much as 1350 lb. gauge, and up to a temperature of 750 deg. Fah., or for non-shock hydraulic pressures as high as 1625 lb. at a maximum temperature of 450 deg. or as high as 2250 lb. at ordinary air temperature. The flanges are all of simple form, either plain raised face, spigot and socket, or tongue and groove. The fittings are of the familiar forms. In a series of tables the recommended dimensions are given for the selected range of diameters and pressures. It seems to be assumed that these simple forms will be suitable for very high pressures even in big diameters. At present there is too little experience to say whether or not that view is justifiable.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 0 6	—
No. 1 Foundry	4 2 6	—
No. 3 Foundry	3 17 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 16 6	3 16 6
No. 1	3 17 0	3 17 0
Cleveland—		
No. 1	3 12 6	3 12 6
Silicious Iron	3 12 6	3 12 6
No. 3 G.M.B.	3 10 0	3 10 0
No. 4 Foundry	3 9 0	3 9 0
No. 4 Forge	3 8 6	3 8 6
Mottled	3 8 0	3 8 0
White	3 8 0	3 8 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 5 0 to 3 6 0	—
(3) Northampton—		
Foundry No. 3	3 2 6	
Forge	2 17 0	—
(3) Derbyshire—		
No. 3 Foundry	3 7 6	—
Forge	3 4 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 6 6	—
No. 4 Forge	3 5 0	—
Basic	3 7 6	—
(4) N.W. COAST— N. Lancs. and Cum.— Hematite Mixed Nos.	4 9 6 (a) 4 12 6 (b) 4 16 0 (c)	— — —

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 15 0	10 10 0
Best	—	
N.E. COAST—		
Iron Rivets	12 5 0	—
Common Bars	11 5 0	—
Best Bars	12 5 0	—
LANCS.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	10 10 0 to 10 15 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 15 0 to 10 0 0	
Gas Tube Strip	11 17 6 to 12 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6 to 7 15 0	7 2 6
Steel Sheets, under 3/16in. to ½in.	10 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	— £15 0 0 to 16 0 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	
Billets	7 10 0 to 10 10 0	
MANCHESTER—		
Bars (Round)	8 12 6	—
„ (Small Round)	7 17 6	—
Hoops (Baling)	11 0 0	11 0 0
„ (Soft Steel)	10 0 0	10 0 0
Plates	8 7 6	—
„ (Lancs. Boiler)	11 5 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	
Intermediate Basic	7 10 0	—
Soft Basic	7 5 0	—
Hoops	11 10 0	—
Soft Wire Rods	9 5 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 10 0 to 6 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	14 0 0 to 14 5 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/6 to 18/9
Block Tin (cash)	289 0 0
„ (three months)	283 0 0
Copper (cash)	55 13 9
„ (three months)	55 17 6
Spanish Lead (cash)	23 18 9
„ (three months)	24 8 9
Spelter (cash)	28 17 6
„ (three months)	28 10 0
MANCHESTER—	
Copper, Best Selected Ingots	60 0 0
„ Electrolytic	61 7 6
„ Strong Sheets	84 0 0
„ Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
„ Condenser, lb.	0 1 1½
Lead, English	25 7 6
„ Foreign	24 10 0
Spelter	29 0 0
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/4 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 15 0	7/3
„ „ 8 p.c. to 10 p.c. „	£22 7 6	6/6
„ „ Specially Refined		
„ Max. 2 p.c. carbon	£36 5 0	11/6
„ „ „ 1 p.c. „	£42 5 0	15/–
„ „ „ 0·70 p.c. carbon	£54 0 0	17/6
„ „ „ carbon free	1/5 per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£12 10 0	for home, £16 for export
„ Silicon, 45 p.c. to 50 p.c.	£12 0 unit	0 scale 5/– per
„ „ 75 p.c.	£19 5 unit	0 scale 6/– per
„ Vanadium	14/3 per lb.	
„ Molybdenum	5/– per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

LANARKSHIRE—	Export.
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	14/–
„ „ Splint	15/3 to 17/6
„ „ Trebles	16/6 to 17/–
„ „ Doubles	16/4 to 16/6
„ „ Singles	13/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/–
„ „ Jewel	15/6
„ „ Trebles	16/–
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/9 to 13/9
Screened Navigation	18/– to 19/–
Trebles	16/6 to 17/–
Doubles	15/6 to 16/–
Singles	13/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9 to 13/–
Secondary Steam	12/3
Trebles	16/3 to 16/6
Doubles	15/– to 15/6
Singles	13/6

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		22/6
Household		42/6 to 58/6
Coke		24/6 to 25/–
NORTHUMBERLAND—		
Best Steams		14/3 to 14/6
Second Steams		13/– to 13/6
Steam Smalls		10/6
Unscreened		13/– to 13/6
Household		21/– to 27/–
DURHAM—		
Best Gas		16/– to 16/3
Second		13/9 to 14/6
Household		21/– to 27/–
Foundry Coke		19/– to 26/–
SHEFFIELD—		
Best Hand-picked Branch	27/6 to 28/6	—
Best Selected House Coal	21/– to 22/6	—
Screened House Coal	19/– to 21/–	—
„ „ Nuts	16/– to 17/6	—
Yorkshire Hards	16/– to 17/–	—
Derbyshire Hards	16/– to 17/–	—
Rough Slacks	10/6 to 11/–	—
Nutty Slacks	8/– to 9/–	—
Smalls	3/– to 5/6	—
Blast-furnace Coke (Inland)	22/–*	—
„ „ (Export) f.o.b.		18/6 to 20/–

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	20/– to 20/6
Second Smokeless Large	19/– to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	18/– to 18/6
Best Black Vein Large	18/6 to 19/–
Western Valley Large	18/– to 18/6
Best Eastern Valley Large	17/6 to 18/–
Ordinary Eastern Valley Large	17/– to 17/6
Best Steam Smalls	13/6 to 14/–
Ordinary Smalls	12/– to 13/–
Washed Nuts	18/– to 21/–
No. 3 Rhondda Large	20/6 to 21/–
„ „ Smalls	16/– to 16/6
No. 2 „ Large	17/– to 17/6
„ „ Through	15/6 to 16/–
„ „ Smalls	13/– to 13/6
Foundry Coke (export)	40/– to 42/6
Furnace Coke (export)	30/– to 32/6
Patent Fuel	23/6 to 24/6
Pitwood (ex ship)	29/– to 29/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	35/– to 38/–
Seconds	28/– to 32/6
Red Vein	25/– to 30/–
Machine-made Cobbles	42/6 to 45/–
Nuts	40/– to 45/–
Beans	30/– to 32/6
Peas	19/– to 21/–
Breaker Duff	8/– to 8/6
Rubbly Culm	8/6 to 9/–
Steam Coals :	
Large	18/6 to 19/6
Seconds	17/6 to 18/6
Smalls	10/– to 11/–
Cargo Through	16/– to 17/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow (b) Delivered Sheffield. (c) Delivered Birmingham. * Official quotation for pig iron producers.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Outlook.

THE only thing that has maintained a little confidence in the trade outlook has been the belief that affairs would settle down with the stabilisation of the franc, but when the situation becomes a little worse every week and manufacturers find it more and more difficult to keep their plants running, except on short time, there is growing fear that the depression has not yet touched bottom. The Government departments are giving out as much work as they can and there are some fair colonial orders, but the general run of buyers are holding entirely aloof, apparently because there is a real and serious contraction of consumption. When the State takes such a heavy toll in the form of taxation there must necessarily be a diminution of the country's purchasing power. The home demand is small, and there is less export buying. So far as iron and steel are concerned, British competition is becoming a serious factor. Efforts to keep up prices have failed. In the case of one contract for the Army makers of manganese sheet steel for the manufacture of helmets combined for the submission of what was practically a uniform price, which the War Department considered to be too high, and it authorised the purchase of the necessary manganese sheet steel from England at an appreciably lower figure. The French makers thereupon reduced their price, but they were too late to secure the order. The colonies are likely to provide a good deal of employment, and estimates were submitted recently for a number of bridges to be constructed in the Upper Volta region of West Africa.

Colonial Works.

Notwithstanding the difficulty of procuring the funds necessary for carrying out public works in West Africa, a good deal of progress continues to be made with the programme of railway and harbour construction, the execution of which will be extended over a number of years. In French West Africa traffic is at present assured by 1850 miles of railway, 2800 miles of waterways and 22,000 miles of routes or tracks which have been laid out for motor vehicles. During the next five years it is intended to improve and extend the port of Dakar and construct wharves at Konakry, Kotonou, and other ports. The work is particularly pressing at Dakar, which is the terminus of two railways, and contracts for harbour improvements, to the value of 80 million francs, have already been given out. Railway construction will also provide a good deal of activity. The line between Thiès and the Niger is found to be too light for the growing traffic and will have to be relaid. The line from the Ivory Coast will be extended to the Sudan and the Upper Volta, and railways are being constructed between Savé, in Dahomey, and the Niger, and between Kotonou and Porto Novo, while several local lines are also being laid. Another great scheme is the irrigation of the Niger Valley for the production of cotton and cereals. Works have been carried out experimentally over a distance of 8 miles, and the results obtained prove that, with irrigation, the Niger Valley is capable of producing considerable quantities of cotton. In the Cameroons the French have found it necessary to abandon the German scheme as being too elaborate and too costly, and they have prepared plans for carrying out works that are indispensable, and for their extension, as required, to meet the future growth of traffic. The port of Douala is to be improved by extending the wharves and deepening the channel for the passage of ships drawing 6 m. of water, building warehouses, &c.

Import Duties.

As Parliament has adjourned without discussing the new Tariff Bill, the Government has been authorised to modify certain existing import duties to permit of the negotiations between France and Germany for an extension of the present commercial arrangement being continued. It is explained that the protection accorded to the engineering industries by the new tariff is less than what had been claimed by manufacturers, who nevertheless accept the new scale of duties, which are equivalent, generally, to 9 to 12 per cent. of the value of machinery and other engineering products imported. In certain cases the duties will be appreciably higher. Meanwhile, the Franco-German negotiations are proceeding laboriously, when they are not temporarily suspended, and it is evident that Germany is endeavouring to break through the barrier of the proposed higher tariffs and is insisting upon the unrestricted importation into this country of agricultural and some other machinery under the most favoured conditions.

The Makhonine Fuel Process.

About two years ago a great deal of prominence was given to a process for producing motor spirit direct from heavy oils by means of an apparatus invented by M. Makhonine, a Russian engineer. It was experimented with on military vehicles, which carried in their tanks crude oil that underwent a process of cracking and refining in the apparatus and was finally delivered to the engine in the form of petrol. M. Makhonine presented his French patents to the Government for military applications, and official statements were made to the effect that the new process had entirely solved the fuel problem by rendering the country independent of foreign supplies of petrol for purposes of national defence. M. Makhonine, however, refused to dispel any doubts concerning this official optimism, and declined the offer of the Société des Ingénieurs Civils to carry out independent and impartial tests with his invention. Negotiations for the formation of a French company fell through, and a small company to work the patents was eventually constituted in Belgium, although nothing further was heard of its operations. In the Chamber of Deputies, recently, the Minister of Public Works declared that it was undesirable for the moment to give information concerning the tests being carried out with the Makhonine apparatus for the production of a motor fuel from national products, and he added that the device was not yet fully developed. This is apparently a new apparatus differing from the old one, which was designed for use with crude oil.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

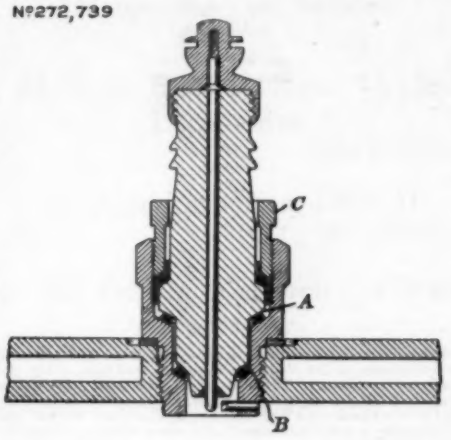
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

272,739. October 11th, 1926.—SPARKING PLUGS, *E. C. R. Marks*, 57, *Lincoln's Inn-fields, London, W.C.* 2.

The object of this invention is to provide a plug which can be readily adapted for ordinary road work or for racing conditions. The insulator is consequently provided with two shoulders A

Nº272,739

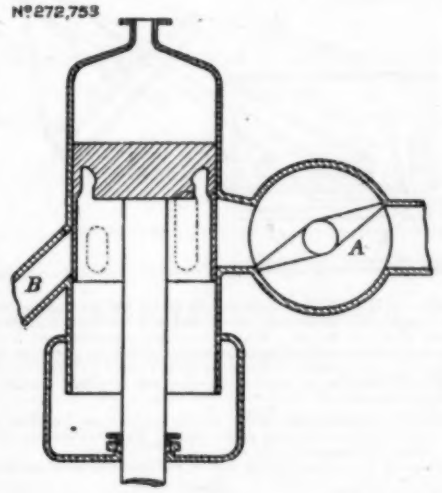


and B, each of which makes joint with the body by means of a gasket and the gland nut C. According to the necessities of the running conditions, in the way of conduction of heat away from the sparking points, either one or both of the gaskets are used.—*June 23rd*, 1927.

272,753. October 28th, 1926.—SCAVENGING TWO-STROKE ENGINES, Scotts' Shipbuilding and Engineering Company, Limited, East Stewart-street, Greenock, and A. Rennie, 63, Eldon-street, Greenock.

In this two-stroke engine a rotary valve A is arranged in the exhaust outlet. This valve is geared to run at half the crank shaft speed, and is so timed that when the piston, on its com-

Nº272,753



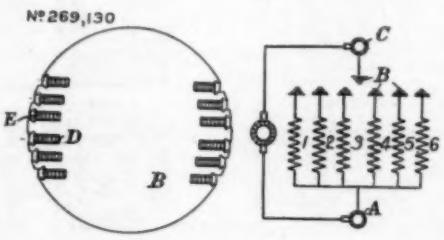
pression stroke, closes the scavenge air admission port B, a supercharge of air, at the pressure of the scavenger, is entrapped in the cylinder. When the skirt of the piston rises to uncover the ports again the rotary valve has not opened, so that air is not wasted by blowing straight through, but it opens in time to give free egress to the exhaust.—*June 23rd*, 1927.

DYNAMOS AND MOTORS.

269,130. October 19th, 1926.—IMPROVEMENTS IN OR RELATING TO ROTATING FIELD MAGNETS FOR TURBO-GENERATORS, Otto Titus Bláthy, of Lövöház u 31, Budapest II, Hungary.

This invention relates to rotating field magnets for turbo-

Nº269,130

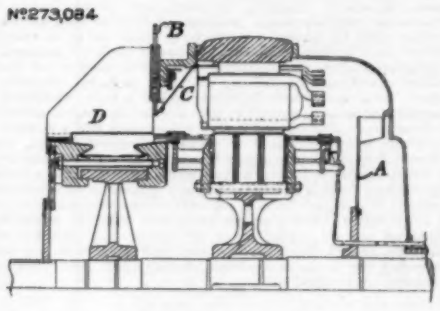


generators of the kind in which the exciter winding consists of at least three coils wound from bare metal strip and placed in grooves in the iron magnet core. The object of the invention is to provide a field magnet of this type in which an effective cooling of the coils is obtained. The field winding consists of coils 1–6, which are wound from bare metal strip and are placed in grooves in the iron core, insulation being interposed in the grooves. The coils are maintained in the grooves by means of metallic wedges. The coils 1–6 are connected in parallel with one another at their inner ends, which lie at the bottom of the grooves and are also connected to one common line conductor A, the other end of all the coils being electrically connected to the iron core B of the field magnet. The iron core B is, in turn, electrically connected to the second line conductor C. Owing to the employment of this construction, the insulation D can be made relatively thin, and, moreover, the insulation between the outside layer of the coils and the wedges E can be omitted because the outermost layer of the metal strip is in electrical connection with the iron core B, and therefore may be in direct contact with the metal wedge. Thus the exchange of heat between the coils and the iron core is facilitated so that, on account of the more effective cooling of the coils, the loading capacity of the winding is considerably increased. Another arrangement of the rotor coils is described.—*June 30th*, 1927.

273,084. June 16th, 1926.—IMPROVEMENTS RELATING TO THE VENTILATION OF DYNAMO-ELECTRIC MACHINES, Robert Townend, of 17, Meadow-bank, Chorlton-cum-Hardy, Manchester, and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, in the City of Westminster.

This invention relates to the ventilation of dynamo-electric machines, and in particular to the ventilation of rotary converters of comparatively high voltage, and has for its chief object to provide an improved construction in which a considerable current of air shall be delivered on the surface of the commutator. A fan A is mounted at the rear end of the arma-

Nº273,084



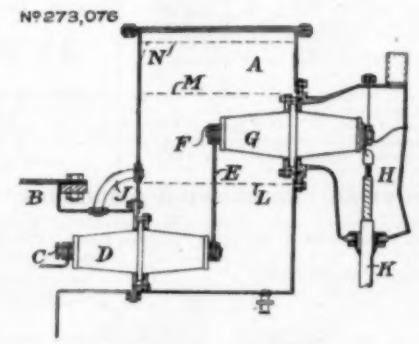
ture, and the machine is substantially enclosed from the outlet of the fan to the inner end or neck of the commutator, so that the air delivered by the fan, together with any air that may be delivered by the armature after passing through the machine is directed over the face of the commutator. An annular plate or baffle B may be arranged between the commutator end of the stator and brush gear, so as to surround the inner end of the commutator and the passage provided by the spider—if any—may be closed by a baffle or plate. C is a shield which deflects the air towards the commutator, and D an arc deflector.—*June 30th*, 1927.

TRANSMISSION OF POWER.

273,076. June 7th, 1926.—IMPROVEMENTS RELATING TO ELECTRIC CABLE CONNECTING DEVICES, Alfred George Ellis, of "Fellthorpe," The Firs, Bowdon, Chester, and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central Buildings, Westminster.

This specification describes an improved arrangement for detachably connecting an electric cable to apparatus, such as a transformer which is enclosed in a tank and immersed in oil. The oil box A is situated on one side and near the top of the main tank B. The conductor C from the main tank B passes out through an insulator D into the oil box A, and it is connected

Nº273,076



within the oil box by a detachable strap E to a conductor F, which passes through an insulator G to the cable sealing chamber H, which is filled with insulating compound. The oil box A is connected with the tank B by means of a pipe J. When it is necessary to break the connection between the cable K and the conductor C, the cover of the tank A is removed and the oil is drawn off until the level L is reached, the normal level of the oil being indicated by the dotted line M. When the oil in the main tank becomes heated, however, it reaches the level N. The oil box A thus acts as a conservator for the oil in the main tank B.—*June 30th*, 1927.

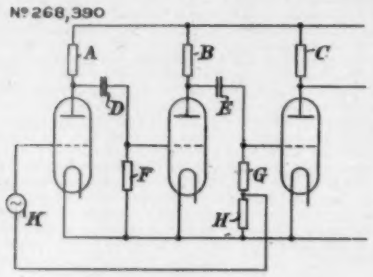
TELEGRAPHS AND TELEPHONES.

268,390. March 28th, 1927.—IMPROVEMENTS IN OR RELATING TO THERMIONIC AMPLIFIERS, Siemens and Halske Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This specification describes an improved method of obtaining reaction or back coupling on thermionic amplifiers. In the diagram, A, B and C are the anode resistances of the three valves, and D and E are the coupling condensers. F and G are the grid leak resistances of the usual resistance capacity amplifying circuit. In the grid circuit of the last valve there is a back-coupling resistance H, which may be variable. The point between the resistances G and H is connected to the alternating-current source, the voltage of which is to be amplified. With

valves having an amplification of 7 and with resistances F and G 60,000 ohms and the resistance H 1200 ohms, a substantially

Nº 268,390



distortionless voltage amplification of 1225 can be obtained over the first two valves.—*June 30th*, 1927.

ELECTRICAL APPLIANCES.

273,025. March 30th, 1926.—IMPROVEMENTS RELATING TO THE MANUFACTURE OF HIGH ELECTRICAL RESISTANCES, James Bradley, of 2, Windsor-avenue, Chadderton, Oldham, Lancaster, and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central Buildings, Westminster.

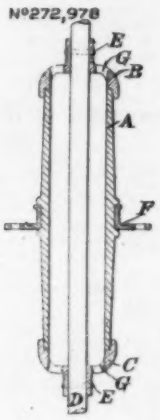
The improved method of manufacturing high resistances described in this specification is specially suitable for grid leaks, anode resistances, lightning arresters, and similar bodies for wireless and other purposes. A synthetic or other resin, celluloid, shellac, pitch or similar substance, is dissolved in a suitable solvent, and a filler, such as good flour, chalk or asbestos, is impregnated with the solution. A suitable amount of finely divided electrically conducting material, such, for example, as carbon, or a metal, which preferably has a high resistance, is incorporated so as to impart to the material the desired electrical conductivity. The solvent is then evaporated and a powder or a material which is friable or readily pulverised results. This is moulded to the desired shape by any of the ordinary and well-known methods adopted for preparing moulded insulating bodies. Sometimes a filler is chosen which is a conductor of electricity, in which case the addition of separate conducting material may be unnecessary. The proportions of the different ingredients employed can be varied so as to obtain the requisite conductivity of the final product and also to ensure the body possessing the requisite hardness, strength and other desirable qualities.—*June 30th*, 1927.

TRANSFORMERS AND CONVERTERS.

272,978. February 23rd, 1926.—IMPROVEMENTS IN DEVICES FOR THE SUPPORT OF ELECTRICAL CONDUCTORS, William Charles Kennett, of "Chase End," Ashley-road, Walton-upon-Thames, Surrey.

This specification describes an insulating support intended mainly for use on transformers of large capacity. The hollow

Nº 272,978

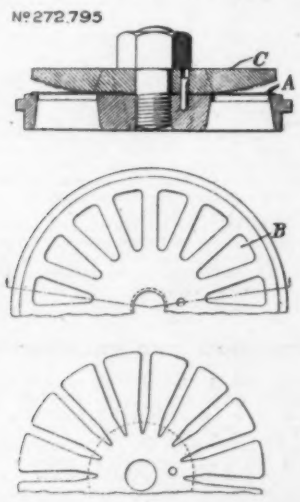


body A is composed of porcelain, and at the ends spiders B and C are provided. D is the conductor, which is secured to the spiders by rivets E. At F there is a metal clamp for holding the support. The apertures G permit of a free flow of air through the porcelain element.—*June 23rd*, 1927.

PUMPING AND BLOWING MACHINERY.

272,795. January 10th, 1927.—AIR COMPRESSOR VALVES, *E. C. R. Marks*, 57, *Lincoln's Inn-fields, London, W.C* 2.

Nº 272,795



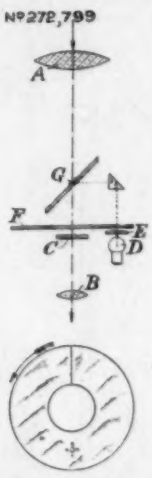
This air compressor valve is claimed to be silent, durable and efficient. It is characterised by the fact that the valve, proper, A, is cut to form a series of radial fingers, as shown in the lower view, which work in conjunction with ports B (see middle view). It will be noted, also, that the stop plate C has a curved lower face. It is suggested that this curvature prevents the valve from sticking to the stop, on account of accumulations of lubricating oil, and then suddenly closing on to its seating with objectionable shock.—*June 23rd*, 1927.

MEASURING AND TESTING INSTRUMENTS.

272,799. January 18th, 1927.—OPTICAL PYROMETERS, R. Hase, 26, Josephstrasse, Hanover, Germany.

In this pyrometer the object glass is shown at A and the eye piece at B. C is a piece of coloured glass, D an electric glow lamp, for comparative purposes, and E a piece of ground glass to diffuse the light. F is a rotatable ring of glass of varying

Nº 272,799



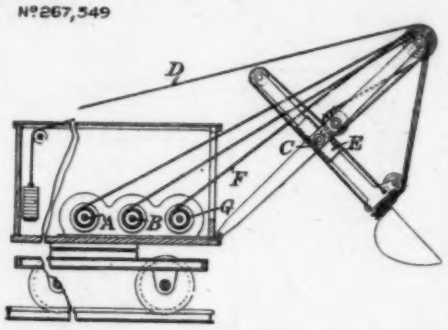
transparency round its circumference. G is the spot where the incandescence of the object to be tested and that of the glow lamp are compared. This spot is of cruciform. By turning the disc F the illumination from the glow lamp can be modified, and it is claimed that with this arrangement the vertical arms of the cross become indistinguishable when balance is effected.—*June 23rd*, 1927.

MISCELLANEOUS.

267,549. March 11th, 1927.—IMPROVEMENTS IN OR RELATING TO POWER SHOVELS, Walter Berger, of 34, Sponholzstrasse, Berlin-Friedenau, Germany.

By simultaneously operating the winches A and B in the same direction the shovel and stick are rocked about the point C, whilst by operating them in opposite directions the shovel is turned about its neck so as to empty it. By pulling the cable D to the rear,

Nº 267,549

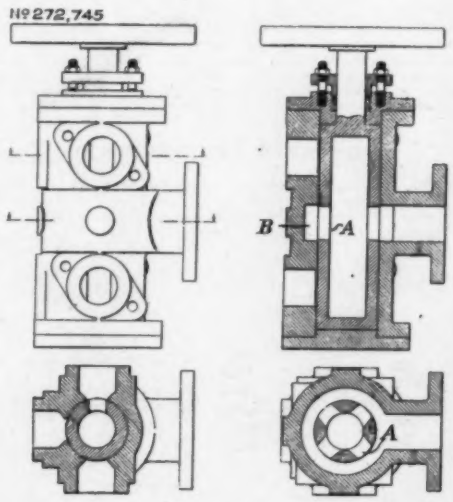


the shovel and stick are lifted axially within the sleeve E, whilst by releasing the cable D the shovel and stick are allowed to drop under their own weight. Partial axial displacement away from the boom is effected by winding up the cable F by means of the winch G. By partially turning the shovel about its longitudinal axis the cutting angle of the shovel edge can be varied at will.—*June 30th*, 1927.

272,745. October 15th, 1926.—MANIFOLD VALVES, The British Soot Blower Company, Ltd., and A. M. Merrylees, Brook-street, Preston.

This valve is intended for use in conjunction with services

Nº 272,745

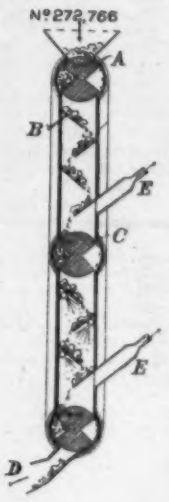


in which a supply of steam has to be given to a number of branch pipes individually. It is of the plug type, is characterised by the fact that the hollow plug is used as a means of distributing the steam to several ports working in conjunction with corresponding delivery branches. The steam finds access to the hollow plug through ports A and an annular passage B.—*June 23rd*, 1927.

272,766. November 20th, 1926.—SHALE RETORTS, G. Menell, 8, Wells-road, North Gate, Regent's Park, London, N.W.

In this retort the material to be distilled is supplied by a hopper to a feeding valve A and cascades over inclined plates B. Heating is effected exteriorily, and by superheated steam at B B.

Nº 272,766



An intermediate feeding device may be introduced at C, while the spent shale is discharged at D. The gas outlets E E are arranged beneath the inclined plates to reduce the amount of solid matter taken away with the gas.—*June 23rd*, 1927.

CONTRACTS.

THOMAS PIGGOTT AND CO., Ltd., of Birmingham, have received an order for the supply and erection of a three-lift vertical guided gasholder, having a capacity of 1,500,000 cubic feet, with steel tank, for the Bombay Gas Company, Ltd., the three lifts being constructed of "Armco" ingot iron sheets and plates. The inner lift is to be 138ft. diameter by 33ft. 6in. deep, and the tank 145ft. diameter. It is interesting to record that Messrs. Piggotts' built the original works and plant for the Bombay Gas Company as long ago as 1863.

THE BRITISH THOMSON-HOUSTON COMPANY, of Rugby, has received an order from the Lancashire Electric Power Company, Ltd., Kearsley, to supply two 32,000-kW M.C.R. turbo-alternators, complete with condensers; two banks of outdoor transformers of 34,000 kVA, each bank consisting of three 11,333⅓ kVA, 33,000/11,000-volt, 50-cycle, single-phase units of the oil-immersed self-cooled type; and three 1250 kVA, three-phase, 33,000/400 volt, 50-cycle, oil-immersed self-cooled transformers for auxiliaries, together with the complete 33,000-volt switchgear and all the low-tension switchgear.

GREAT WESTERN RAILWAY has officially announced that the following contracts have been placed:—(*a*) Overhaul of No. 6 dumb hopper barge—Harris Bros., Ltd., Cambrian Dry Docks, Swansea; (*b*) overhaul of ss. Sir Richard Grenville—The Bickle Engineering Company, G.W.R. Docks, Plymouth; (*c*) cleaning and repainting bridges, tips, buildings, &c., at Swansea Docks—Arundel (Painters), Ltd., 63, King's Arcade, Bradford; (*d*) overhaul of tug Horace—Mr. G. W. Thompson, Wear Engineering Works, Alexandra Docks, Newport; (*e*) supply of two 6-ton hand-travelling cranes for Cardiff Docks—Charles Willetts (Junior), Ltd., Colonial Works, Cradley Heath; (*f*) supply, delivery and erection of two 4-ton underhung jib cranes for the Mole, King's Dock, Swansea—Holt and Willetts, Cradley Heath; and (*g*) provision of a 30 cwt. electric lift for Newport (High-street) goods station—Wadsworth and Sons, Ltd., High-street, Bolton.

LAUNCHES AND TRIAL TRIPS.

BERTA, twin-screw oil tanker; built by Harland and Wolff, Ltd., to the order of Anglo-Saxon Petroleum Company, Ltd.; dimensions, 305ft. by 50ft. by 15ft.; to carry oil in bulk. Engines, two sets of triple-expansion, 13½in., 23½in., 36in., stroke 27in.; pressure, 180 lb. per square inch; burning oil fuel; launch, June 30th.

ERICA, steel port lighter; built by Harland and Wolff, Ltd., to the order of Argentine Navigation Company (Nicholas Mihanovich), Ltd., Buenos Aires; dimensions, 90ft. by 28ft. by 7ft. 6in.; to carry 350 tons deadweight on a draught of 7ft.; launch, June 30th.

BOLIVAR, twin-screw oil tanker; built at Hebburn Shipyard by Palmer's Shipbuilding and Iron Company, Ltd.; to the order of the Venezuela Gulf Oil Company, of Caracas; trial trip, July 7th, 1927.

MIMMI, steamer; built by D. and W. Henderson and Co., Ltd., Glasgow; to the order of Jas. and Alexr. Brown, Sydney, N.S.W.; dimensions, 250ft. by 37ft. by 17ft. 4in. Engines, triple-expansion, 19½in., 32½in. and 53in. by 42in. stroke, pressure, 185 lb. per square inch; constructed by D. and W. Henderson and Co., Ltd. A mean speed of 13 knots was attained on recent trial trip.

COMPETITION OF INDUSTRIAL DESIGNS.—A selection of the designs received in the competition of Industrial Designs, 1927, for prizes and scholarships offered by the Royal Society of Arts and well-known manufacturers will be exhibited, by permission of the Board of Governors, in the Indian Pavilion of the Imperial Institute, South Kensington, from July 30th to August 31st next, every week-day from 10 a.m. to 5 p.m. (Sundays, 2.30 to 6 p.m.). The Exhibition will be open free of charge and no tickets will be required. It will include designs in architectural decoration—wrought iron gates for a City Company, entrance hall for a block of flats, topographical drawings, &c.—textiles, furniture, printing and book-production, china, earthenware and glass, as well as designs for posters, showcards, lay-outs, cartons and price lists. A bureau of information has been established at the Society in connection with the competition, at which are kept the names and addresses of exhibitors who desire to obtain employment as designers. These lists are at the service of manufacturers in search of designers